THE AMERICAN GAS LIGHT JOURNAL

REDMAN & KENNY, N. Y.

PUBLISHING OFFICE No. 42 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

VOLUME LXXIX. No. 8. Whole No. 1,472. | NEW YORK, MONDAY, AUGUST 24, 1903. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
THOMAS J. CUNNINGHAM and ELBERT P. CALLENDER, Editors.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 42 Pine Street, New York.

Telephone.—2996 John.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $5 (£1—25 francs). All payments to be made in advance. Single copies, 10 cents.

Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

The American News Company, Nos. 39 and 41 Chambers street, New York, are agents for this JOURNAL. Newsdealers will send orders to them.

Remittances should be made either by post office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

Collections are invariably made directly from this office for subscriptions advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

Books.—We will forward by express, at publisher's lowest rates, any book—scientific or otherwise—to any address in the United States or Canada. We would suggest to our patrons that to avoid the risk and expense consequent on sending us the money (we do not send books C. O. D.), that orders for books be sent us through the Purchasing Department of the American Express Company.

The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

CONTENTS.

An Asterisk (*) denotes an illustrated article.

EDITORIALS—
Briefly Told 281
"All American Gas Wrinkles"—Notes.
Liquid Air: Its Manufacture, Distillation into Commercial Oxygen and Nitrogen, and the Application of Oxygen in the Industries, Especially for Use in Connection with Illuminating Gas, by Mr. G. A. Bobrick 282
Our Customers and Their Complaints, by Mr. D. Decker 285
The Practical Protection of Metal Surfaces in Gas Plants, by Mr. L. P. Lowe 285
Present Conditions in the Anthracite Coal Regions 288
Insurance Inspection, by Mr. J. H. L. Coon 289
The Possibilities of Future Economies in Electrical Illumination, by Mr. W. A. Chaman 290
CORRESPONDENCE—
A Criticism 292
ITEMS OF INTEREST FROM VARIOUS LOCALITIES 292
A Hint from the Fox River District—The Hocking Valley Gas Company—Sensible Planning for the Rendering of Gas Bills—A Suit—Betterments at Lexington, Mass.—Gas for Ocean Grove—Gas Rates, Pottsville, Pa.—Another Shift, Stroudsburg, Pa.—Additional Storage Capacity, Louisville, Ky.—The Nassau County (L. I.) Gas Company—Some Figures on Operation, Holyoke, Mass.—From Sparrows' Point to Baltimore—And Other Items.
The Market for Gas Securities 294

BRIEFLY TOLD.

"ALL AMERICAN GAS WRINKLES."—We are in receipt of copies of a pamphlet bearing the title "All American Gas Wrinkles," which is as welcome a tome as any that ever came our way. As its name implies, it is a collection of all the "Wrinkles" that have been prepared for our Associations at their meetings between the years 1891 and 1900. The editing and compiling were done by Mr. William E. Steinwedell; and the Western Gas Association, at the instance of a suggestion made at its Chicago meeting, May, 1900, by Mr. Frederick H. Shelton (now President of the Western Association) is responsible for having ordered the work performed. As Editor Steinwedell wrote us, in forwarding our copies: "The Wrinkles have been arranged in logical order, which should make them more useful to gas companies, and also prove of assistance to the Editors of the Wrinkle departments in Associations other than the Western, in preventing duplication in new issues." Like everything that he does, Editor Steinwedell has performed his task well, and we are quite sure that his work will be thoroughly appreciated by all who are fortunate enough to secure a copy of his aptly named pamphlet. Each member of the Western Gas Association will receive a copy free of charge, and a few volumes are on general sale, at the price of $1 each. Orders for the latter should be sent to Mr. W. E. Steinwedell, at his address, Citizens Building, Cleveland, O.

NOTES—

MR. DAN. P. EELLS, of Cleveland, O., died at his home, in the district of that city known as Rocky River, the morning of the 14th inst. Deceased, who was born in Westmoreland, Oneida county, N. Y., April 16, 1825, became a resident of Cleveland in the early sixties, and at the time of his death was as representative a citizen as the city possessed. For 25 years he was active in the direction of the business affairs of the Cleveland Gas Light and Coke Company. His widow, two sons and a daughter survive him.

"L. T.," WRITING from Guthrie, O. T., the 17th inst., says: "The Guthrie Gas Light, Fuel and Improvement Company has heen chartered with a capital stock of $100,000. The Directors are Messrs. Henry S. Clark, of Chicago, and William R. Payne and O. P. Cooper, of this place.

RUMOR has it that Mr. Allan Pollok intends to resign his place as business manager of the San Francisco Gas and Electric Company, in order to act as manager of the new hotel—the St. Francis—now being completed. Rumor also has it that his successor in the management of the San Francisco Gas and Electric Company will be Mr. T. T. Williams, for years in charge of the business affairs of the San Francisco *Examiner*.

SUPERINTENDENT PULLEN, of the Ottawa (Ills.) Gas Light and Coke Company, has completed his planning of a better system of distribution in that city. The plan is a complicated one, and its carrying out will keep Mr. Pullen busy until frost arrives. It also entails the expenditure of several thousand dollars.

THE City Council of Zanesville, O., proposes to sell the city's holding in the capital stock of the Zanesville Gas Light Company, which hold-

LIBRARY OF CONGRESS, AUG 24 1903, SMITHSONIAN DEPOSIT

ing amounts to 213 shares of the par value of $25 each. The dividend return on the stocks is well over 12 per cent. per annum.

It is said that M. J. McDermott and Henry W. French, two well-known business men of Mobile, Ala., will apply to the General Council of that city for the right to there construct and operate an opposition gas works. It is not likely that their petition will be favorably considered.

At a recent meeting of the Monterey County (Cal.) Gas and Electric Company Mr. M. V. McQuigg, formerly the Company's Secretary, was elected President, vice Mr. O. Z. Hubbell, deceased; and Mr. R. C. P. Smith was elected Secretary and Treasurer.

Under the agreement between the authorities of Northampton, Mass., the Northampton Gas Light Company and the Northampton Street Lighting Company, the public lighting of that city for the next 3 years will be paid for on the following basis: 23 all night arcs (1,200-candle power), at $100 per annum each; 100 arcs, midnight service, $74 each; 115 Welsbach street lamps, midnight service, at $24.60 per lamp per annum.

The authorities of San Leandro, Cal., have given up all thought of constructing an electric lighting plant for operation on municipal account.

The preliminary report of the United States Geological Survey makes the total oil production of the United States for 1902, 80,894,590 barrels, valued at $69,610,348. This is the largest quantity ever known in the history of the country. The production for 1901 was 69,389,184 barrels. At this rate of increase our production of crude oil will soon reach 100,000,000 barrels per annum. The gain during the last year was 11,505,406 barrels in quantity, and $3,192,963 in value. This increase comes almost entirely from Texas and California. The product of these latter States sold at comparatively low figures, and brought the average value of the oil production of the entire United States down to 86 cents a barrel. Ohio proved the leading State in the production of petroleum in 1902. California ranked second, with West Virginia third, Pennsylvania fourth, Texas fifth, Indiana sixth and New York seventh. The yield of Louisiana, Colorado, Kansas, Indian Territory, Kentucky and Tennessee was less than 2 per cent. of the total production.

At the June meeting of the Philadelphia Foundrymen's Association a committee was appointed for the purpose of aiding the authorities of the Louisiana Purchase Exposition in presenting to the visitors a model foundry in actual operation. This committee, consisting of Elmer E. Brown, Chairman; Thomas Devlin, Howard Evans, Alex. E. Outerbridge, Jr., and Geo. H. Davis, met at room 306, Bourse, on August 11, for organization. After considering the situation the Chairman was instructed to communicate with Joseph A. Holmes, chief of the Department of Mines and Metallurgy, at whose suggestion the committee was appointed, in order to define their work and place it in such shape that a formal announcement can be made to the foundry and allied trades. It is hoped that the committee will be able to report progress in the announcement of the September meeting of the Philadelphia Foundrymen's Association. The proposed model foundry would serve as an exhibit of all foundry equipment and material, such as cupolas, blowers, cranes, flasks, molding machines, sand mixers, rattlers, core ovens, sand blast, heating and ventilating apparatus, pneumatic chippers, rammers, lifters, etc. Ordinarily these articles would be scattered among the various exhibits, whereas under the proposed plan they would be seen in actual operation and would be interesting and instructive to all foundrymen.

The Hudson Oil and Gas Company, to operate in Maricopa county, Ariz., has been incorporated by Messrs. G. B. Hudson, J. A. Bermingham and C. D. Martin, with a capital of $1,000,000. The principal place of business is Phœnix, Ariz., and a secondary headquarters is to be maintained in Chanute, Neosho county, Kas.

At a meeting of the Board of Public Works, Kansas City, Mo., held the 17th inst., bids for supplying 1,000 incandescent gas burners for the city's use were opened: Only two tenders were made, one by the Cleveland Vapor Light Company at $1.12 per burner, the other being from the Columbia Lighting Company, of Chicago, whose bid was $1.18 per burner. Samples of the burners it was proposed to supply were submitted. The propositions and the samples were referred to a special committee, Gas Inspector Harvey being prominent thereon, for examination and report.

Liquid Air: Its Manufacture, Distillation into Commercial Oxygen and Nitrogen, and the Application of Oxygen in the Industries, Especially for Use in Connection with Illuminating Gas.

[Read by G. A. Bobrick, Engineer of Technology, at the 11th Annual Meeting, Pacific Coast Gas Association, San Francisco, Cal., July 21-23.]

The object of this paper is to explain how the air which we breathe, and which only a quarter of a century ago was considered a permanent gas, is now reduced to a liquid state, and also to explain the process of the fractional distillation of liquid air into its constituent gases, oxygen and nitrogen, and the value of the liquid and the gases distilled from it for use in the various industries, and especially the application of commercial oxygen in connection with the gas industry, the term "commercial oxygen" meaning a gas containing from 60 per cent. to 80 per cent. of oxygen.

To make the subject clear I will, first, briefly review the history of the liquefaction of gas, and then I will describe the processes now employed in the manufacture of liquid air and its distillation.

Air, as is well known, is a mechanical mixture of about 20 per cent. of oxygen and about 80 per cent. of nitrogen by volume. It also contains about 0.04 per cent. of carbon dioxide, commonly known as carbonic acid gas, and about 1.22 per cent. of aqueous vapor by weight, at the average temperature and humidity of the atmosphere. To successfully manufacture liquid air it must be completely, or as nearly as possible, freed from aqueous vapor and carbonic acid gas.

All substances known upon this earth are of one of three classes, they being either solids, liquids or gases. It has been known for a long time that the difference between these three forms of matter is merely a question of temperature. For instance, ice is a solid, but by heating it a little it becomes a liquid, and when heated still further it becomes steam, having some of the properties of a gas, and what is true of ice is true of metal and all solid substances. When steam becomes cold it is again converted to water and cooling the water sufficiently causes it to again become ice. Air is also a gas, and can be converted to either liquid or solid state the instant it becomes cold enough.

The passage of a substance from the solid to the liquid state, or from the liquid to the gaseous state, generally involves a change in volume, and in the case of many substances the liquid state is that of its smallest size. It follows that, to produce liquefaction of a gas, the first thing we should naturally try to do is to reduce it in volume, and the simplest way to do this is by pressure.

It is probably within the memory of all of us that certain gases and mixtures of gases, such as oxygen, nitrogen, air, hydrogen, etc., were looked upon as permanent or stable gases. They were believed to be so for the reason that all attempts to liquefy them had utterly failed, notwithstanding the fact that they had been subjected to such enormously high pressures as 50,000 pounds to the square inch; and it was not until it was fully understood, as first shown by Dr. Andrews, of Scotland, in 1869, that pressure alone, or at least pressure at an insufficiently low temperature, can never change the gaseous condition of these substances. In other words, it was found that there exists, for every gas, what is now known as its critical temperature—*i. e.*, the temperature above which the application of pressure, no matter how great, will not bring about liquefaction.

Besides its critical temperature, each gas has also its critical pressure, and when a gas is compressed to the critical pressure and cooled to the critical temperature, the least increase in pressure or decrease in temperature will convert it into a liquid.

The following table gives the critical temperatures and pressures, and the boiling points of some gases:

Name.	Critical Temperatures, in Degs. F.	Critical Pressures, in Atmospheres.	Boiling Points of Liquids at atmospheric Pressure. Degs. F.
Water	689 above zero	200	212 above zero
Ammonia	266 " "	115	27 below "
Carbon dioxide	88 " "	75	112 " "
Oxygen	181.4 below "	50.8	294.4 " "
Nitrogen	231 " "	35	318 " "
Air	220 " "	39	312.6 " "
Hydrogen	389 " "	20	405 " "

The term critical pressure must not, however, be misunderstood, for gases will liquefy at pressures much lower than those above given, provided their temperatures are correspondingly reduced. Air, for instance, will liquefy at atmospheric pressure, providing its temperature is reduced to somewhat below 312.6° below zero, F.

It is well known that cold increases molecular attraction and diminishes repulsive force. There is a theoretical point of cold never yet attained, which is termed the absolute zero (459.4° below zero, F.). At this point heat ceases, the molecules no longer vibrate and absolute cold exists. If a body were reduced to the absolute zero, where the motions of the molecules cease, pressure would be without effect upon it. As the only power of pressure is to shorten the paths of vibration of the molecules. The term critical pressure is, therefore, used to describe the pressure required to liquefy a gas when it is at the critical temperature.

When this fact became recognized, the problem of liquefying the then supposed permanent gases was once more attacked, and practically solved, in 1877, by Prof. Cailletet, in France, and Prof. Pictet, in Geneva, almost simultaneously.

A gas when compressed becomes heated, and if this compressed gas is re-expanded it practically absorbs the same amount of heat as that generated by compression. The re-expanded gas will, therefore, be cooled to its original temperature, but if this compressed gas is cooled down before it is allowed to re-expand, it will not contain sufficient heat in itself to effect its own expansion, and, therefore it will abstract heat from its surroundings, and by so doing it will produce the sensation of cold.

It is the ingenious application of this principle which has resulted in the liquefaction of all known gases, including hydrogen, argon, helium and atmospheric air; and we are indebted to the indefatigable and untiring efforts of Mr. Chas. E. Tripler, of New York, extending over 12 years, and to his genius and skill, in overcoming many great difficulties, that air can be, and is now, liquefied on a comparatively large scale and at a relatively low cost. While Mr. Tripler was not the first to liquefy air, small quantities having been previously liquefied at an enormous cost by other investigators, he was the first one to render the process a practical one, and once again did American ingenuity and American skill in mechanical devices triumph over competitors of all nations and add another victory to the many of which we all feel so proud.

At present we know of three processes by which air may be liquefied in large quantities and at reasonable cost, namely:

The free expansion, self-intensive process; the adiabatic expansion, self-intensive process; the combined free and adiabatic expansion, self-intensive process.

Briefly, the process of manufacturing liquid air by any one of these three processes consists in, first, compressing the air, then abstracting the heat produced by compression by some cooling medium, and subsequently expanding it into a suitable vessel, and directing the current of expanded cold air over or along the pipes through which the incoming compressed air flows. The cooling effect is thus made cumulative and the incoming compressed air gradually drops in temperature until it reaches its "critical temperature," and upon further expansion part of it liquefies.

I will illustrate the systems by sketches (shown on blackboard), and will explain the processes with the understanding, of course, that the sketches of the apparatus are mere diagrammatic ones without regard to scale or detail. The various kinds of apparatus used in the manufacture of liquid air and its constituent gases differ materially in arrangement, scale and detail, though not in principle; but before explaining them I will briefly point out the difference between the free and adiabatic expansion processes for the manufacture of liquid air.

By the free expansion process I mean that wherein the air expands, through a throttle valve or orifice, from a vessel in which it is maintained at a high pressure into a vessel maintained at a low pressure, and by doing so it performs internal work only.

The drop in temperature due to free expansion is about $\frac{1}{4}$° F. for every 15 pounds drop in pressure at normal temperature, and this is gradually increased as the temperature of the air decreases before expansion.

To economically manufacture liquid air by the free expansion process it is necessary that the air should be compressed to from 3,000 to 4,000 pounds to the square inch in at least four stages, and that the heat of compression be abstracted during and after each stage of compression. Theoretically, the drop in temperature, due to free expansion from a pressure of say 4,000 pounds to the square inch (at 60° F.) to atmospheric pressure, is equal to about 137° F.

By adiabatic expansion I mean that wherein the air is expanded in a motor or turbine without the addition of external heat, or abstraction of internal heat, and in so doing performs external work. The drop in temperature will, of course, depend upon the amount of work done. Theoretically, the drop in temperature due to adiabatic expansion, from a pressure of say 60 pounds to the square inch to atmospheric pressure, will equal about 199° F.

In using this method practically, I propose to compress air to about 300 pounds per square inch. It will, therefore, be seen at a glance that the adiabatic expansion process is the most efficient and economical one as, besides the great gain in thermal advantages, about 50 per cent. of the work done in the compressor may be recovered and used for compressing additional air.

In the third process named, I propose to compress the air to from 3,000 to 4,000 pounds to the square inch, then expand it through a throttle valve to about 60 pounds to the square inch, using the air so expanded for cooling the incoming compressed air and again expanding it adiabatically in a motor to atmospheric pressure.

A 500-horse power plant will produce liquid air by the first process at a cost of about 5 cents per gallon, by the third at about 3 cents per gallon, and by the second at less than 1 cent per gallon.

Liquid air is yet in its infancy, and from the many possibilities suggested at present, we know of but few uses to which this wonderful substance may be applied commercially and economically, but oxygen derived from the fractional distillation of liquid air has numerous applications in the industries, and one of them, and perhaps the most important one, is its use in conjunction with illuminating gas. Among the possibilities suggested are these: Refrigeration; power; explosives; purification of chemicals; ozonizing or sterilizing of water; ozonizing or oxidizing wines, liquors, etc.; medical and surgical purposes; lighting and heating.

The first seven enumerated, although of vital importance to mankind, do not come within the scope of this paper, and, therefore, I will pass them without comment. The eighth is the one of chief interest to the gas industry, and I will mention the uses to which commercial oxygen may be applied commercially and economically.

When Galvani noticed the jerking frogs' legs, when Watts observed the action of steam in the tea kettle, when Oersted found that a magnet was influenced by an electric current, none of these discoveries then seemed to be of more than scientific interest, yet they have revolutionized the existence of mankind, and have done more for the progress of the world and for the civilization of nations than has the combined activity of all rulers and legislators.

Civilization has known great changes since small quantities of liquid chlorine, ammonia and other easily liquefiable gases were obtained for the first time by Faraday in 1826. About 35 years ago Prof. W. Simon, now of Baltimore, Md., and formerly assistant Professor at the University at Giessen, Germany, took in a carriage a small iron flask containing 2 pounds of liquid carbon dioxide from that university to the university of Marburg. This liquefied carbonic acid gas was exhibited by the Professor as a great scientific discovery, and its wonderful properties were demonstrated before a class. It was transported in a carriage for the reason that the railroad officials positively refused to handle and transport so "dangerous and explosive" an article as this liquefied carbonic acid gas was then believed to be; but to-day thousands of tons of this substance are manufactured and transported by freight and other transportation companies all over the world, without a thought of danger.

From my own experience I know that only 4 years ago the railway and express companies refused to handle and transport liquid air for fear that it might explode, wreck and burn up the train, and only last November the Wells Fargo Express Company refused to accept from me a consignment of liquid air from Los Angeles for San Francisco, I being obliged to send a special messenger, who took the liquid air with him into a Pullman car and delivered it safely to the consignee in San Francisco; but we now ship liquid air daily, and the express companies accept it without fear of danger.

Oxygen as an Aid to the Gas Industry.—It is well known that animal life in all its forms depends upon the presence of oxygen in the air, as without that element vital functions cannot be performed. Oxygen is also one of the elements of combustion, and every fire and commercial artificial light, other than electric light, is sustained only by an abundant supply of it.

Illuminating gas, as is well known, readily burns in the air with the evolution of heat, which can be greatly intensified by the introduction of a jet of oxygen in the center of the flame. The illuminating gas burning under these conditions is furnished with a supply of oxygen from the air on the outside and almost pure oxygen from the interior, producing an intensely hot oxyhydrogen flame.

Notwithstanding its enormously high temperature this oxyhydrogen flame emits only a feeble light, because of the absence of proper radiants, but we need only apply its high temperature to some non-volatile and infusible solid to cause a considerable portion of the heat to be converted into radiant energy, which streams forth as a dazzling,

white light. A piece of quicklime may serve as a radiator, but oxide of magnesia is better, and zirconia excels both.

Many successful experiments have been made in the application of a mixture of oxygen and illuminating gas for the production of light, but the great drawback to this system of illumination has been the exceedingly high cost of oxygen; but now, with an abundant and cheap supply of that substance derived from liquid air, we may reasonably expect that this problem, of such vital importance to the gas industry, will speedily be solved.

Experiments in this line have been carried on at the Queen's barracks of the British War Department, the flame of an oxyhydrogen burner, placed 18 feet high, being directed against a piece of quicklime and the light reflected from a mirror. It was so intense that, at 100 yards distance from the light, the smallest type could be read. A smaller light surrounded by a glass globe was tried and found to be so efficient that, at 30 yards distance, a pin could be distinguished lying on the pavement.

In New York city I constructed an oxyhydrogen lamp on the principle now illustrated before this Association. This lamp consumed on an average a mixture of 10 cubic feet of illuminating gas and 8 feet of commercial oxygen per hour. It was placed at a height of about 25 feet from the ground, at a place where there were no other artificial lights. The flame was directed against a piece of quicklime and reflected from a silver plated mirror, 15 inches in diameter, and though the night was very dark I could easily read the smallest type of a newspaper at a distance of about 250 yards from the light.

Commercial oxygen gas mixed with commercially pure hydrogen gas, water gas and coal gas, were also tried in the experiments, and also oxygen saturated with a solution of naphthaline in petroleum, benzine and many other substances; but it appeared that the most practical method was the mixing of ordinary illuminating gas with commercial oxygen, and the heat of this flame properly applied produced a most excellent light, superior to the electric arc, and devoid of the disagreeable violet color of the latter.

As above stated, the principal drawback to the introduction of the oxyhydrogen light for purposes of ordinary illumination has been the heretofore exceedingly high cost of producing oxygen (over $30 per 1,000 cubic feet); but since commercial oxygen can now be produced for less than 25 cents per 1,000 cubic feet, with the prospect of a still further reduction to 15 cents per 1,000 cubic feet, the oxyhydrogen light will soon come into general favor. The illuminating devices and the three 3,000-candle power oxyhydrogen lights now exhibited before this Association have not yet reached a sufficient stage of perfection, but this is due to the fact that only few experiments have been made in this line for the reason that, owing to the high cost of oxygen, there has been practically no demand nor development in this line; but, as has been wisely said, "Necessity is the mother of invention," and having now both cheap oxygen and illuminating gas, I dare predict that, as the electric arc light partly replaced gas light, so will the oxyhydrogen light partially replace the electric arc lamp, which, as is well known, has never reached what may be called the stage of perfection.

I will take the opportunity of answering in this paper an objection which has been raised against the oxyhydrogen lamp, in that the calcium stick requires replacing. While I admit that this is so, it cannot be considered a more serious objection than is the carbon of the arc lamp, which also requires renewing. But this objection to the oxyhydrogen light is being overcome by the lately discovered rare earths for making the refractory cylinders, and these will last 30 days or more, even in very severe weather. Furthermore, in recent experiments I have been able to do away with calcium sticks altogether, and I hope that within a short time I shall be able to exhibit a lamp which will produce the same great amount of light as at present without the use of calcium or any other refractory substance.

Cost.—Eight cubic feet of an average quality of illuminating gas, if burned in about 6 cubic feet of commercial oxygen, will produce a light equal to that given by an electric arc consuming nearly 1 kilowatt per hour, and giving a light of over 2,000 candles. At present, illuminating gas retails in the larger California cities at $1 per 1,000 cubic feet, but not knowing the cost of producing this gas I will assume, for the purpose of this paper, that the manufacturer's cost is say 50 cents per 1,000 cubic feet, and the cost of commercial oxygen 25 cents per 1,000 cubic feet:

8 cubic feet of gas at 50 cents per 1,000.....	40 cents.
6 " " oxygen at 25 cents per 1,000....	15 "
	55 "

This is but a little over one-half cent per hour for a light of over 2,000-candle power. The city of Los Angeles, for sake of illustration, and with which situation I am familiar, pays for about 1,100 electric arc lamps (which are supposed to be of 2,000-candle power each, but which are in reality of only about 1,000-candle power, and at times less), at the rate of $81 per lamp, per annum for about 3,500 hours use, or at the rate of about 2.3 cents per lamp per hour. It will, therefore, be readily seen that the oxyhydrogen light can more than successfully compete with the arc lamp, not only for general illuminating and the lighting of halls, theaters, churches, stores, etc., where a much higher price is usually obtainable, but also for street lighting, and oxyhydrogen gas consuming appliances can also be successfully and economically used for general domestic and manufacturing purposes.

The Oxyhydrogen Blowpipe in the Steel and Iron Industries.—By the combustion of illuminating gas in commercial oxygen a temperature sufficiently high for the welding of steel and iron can be readily obtained, thereby removing the present objectionable method of using rivets in the construction of steel and iron frames for buildings, bridges, boats, boilers, and, in fact, all similar metallic structures. Riveting is not alone expensive, but the riveted seams are the weakest parts in iron and steel structures. Boilers examined after explosions, and railroad bridges after collapse, show that in the great majority of cases the ruptures occurred at the riveted joints. The electric current which has been freely suggested for this use, cannot compete with the oxyhydrogen blowpipe, for the reason that the sectional areas of the pieces to be welded are generally too great and their electrical conductivity also presents great obstacles, in addition to which the oxyhydrogen blowpipe method is cheaper and by far easier and safer to handle. The gases can be conveyed without material loss from a central station to the places desired, in either metallic or rubber tubes, no special mechanism being needed and there is no danger of shocks as with electricity.

In the steel and iron forging and welding industries commercial oxygen will also play an important part. Under present conditions, when it is necessary to raise the temperature of large pieces of metal above say 1,200° F., the consumption of coal, as compared with the weight of the metal, is considerable. This is due to the fact that, while in the first stages of heating by a coal fire having a temperature of say 2,500° F., the difference in temperature between the metal and the fire is great enough to permit the heat to penetrate the metal readily with the increase in temperature of the metal, the difference in temperature between the metal and the fire is decreased, and, therefore, the higher the temperature of the metal the slower is the penetration of heat into it, the result being that a large amount of heat is wasted by conduction and radiation.

The temperature of an oxyhydrogen flame can easily be raised to 4,000° F. and over, and if a temperature of say 2,500° F. is needed, the difference between the heat of the flame and that of the metal is always great enough to permit of the rapid penetration of the heat. Moreover, in the ordinary flame the oxygen necessary for the combustion of the coal is derived from the air, which contains but 20 per cent., the balance 80 per cent. being nitrogen, which has to be heated to the temperature of the flame at the expense of the coal and oxygen, thus entailing a great loss of heat, in addition to which, if the nitrogen reaches the metal at a temperature lower than that of the metal, a cooling effect results.

What applies to forging and welding also applies to smelting, and I believe the day is not far distant when commercial oxygen will be used in our smelters, furnaces and forges, in place of air as now applied.

As a direct motive power for running engines liquid air has but little value, as 1 cubic foot of it (7½ gallons) will upon expansion, at 32° F., develop theoretically only about 10,530,000 foot pounds (about 5½-horse power hour) and in practice much less. However, where the question of expense is of secondary importance, as in the propulsion of automobiles, airships and submarine boats, liquid air is an ideal power, as it is lighter than any other known source of power and can be used with ease and perfect safety.

In conclusion I wish to state that liquid air is yet in its infancy and that it is not wise for us to prophesy what it will or will not do. Our knowledge and means of handling and using it increase daily, and while exaggerated and unfounded claims have been made for it by the misinformed, others have not given it due credit, so let us remember that this is an age of wonderful discovery and invention, and that we are only beginning to know the world, its forces and resources, and because we cannot to-day see the whys and wherefores of all scientific truths we should not be incredulous. The experience with the telegraph and telephone, gas and electric lights, electric cars, the air crane, etc., is still fresh in our mind. Liquid air is now added to the list, and

we are prepared to see its use before long in many ways that cannot be even imagined to-day. But if one should ask of what value is liquid air or oxygen to-day, aside from applications to medicine, surgery, scientific research and some minor industries, I will reply by quoting the words of the illustrious Benjamin Franklin, who to a like question replied: "Of what use is a baby?"

Our Customers and Their Complaints.

[A paper read by MR. D. DECKER, of Santa Rosa, Cal., at the 11th Annual Meeting, Pacific Coast Gas Association, San Francisco, July 21–23.]

I have noticed in the JOURNAL recently that our customers are receiving unusual attention from writers and managers in charge of the business of selling light. I have always quietly regarded this feature of our business as most sensitive, and, therefore, requiring our most prompt, intelligent and conscientious consideration. I have found pleasure in studying the art of pleasing, and delight in acting the role of "Chief Hypnotizer," as it is only through the exercise of diplomacy and tact that one is enabled to gain the attention of those who are at first antagonistic. When a first-class kicker comes forth seeking whom he may devour, it is usually the electric meter or gas bill that is the immediate object of his wrath. I usually appear not to take him seriously at first, and perhaps tell him that, when I was younger and better looking, I was a student of astronomy, and as the result of my research, had become convinced that the tides, or the moon, cause meters to be unkind to the consumers. In short, by some pleasantry I convince him that I am in a good humor and try to get him in a happy frame of mind before getting down to business; otherwise he will not listen to what I have to say and becomes more rebellious as I proceed.

I find it well to convince the consumer that I am personally interested in his case, by reminding him that our business depends for its success entirely upon the good will of our patrons. If he persists in telling me that the lighting business is a cinch and that the public will soon be unable to breathe, except through a corporation or trust, I refer him to the Standard Oil Trust which sells the poor man light cheaper than was ever known. Gas and electric consumers as a whole look upon a corporation as a hideous monster with grasping hands, without soul or heart, known only by name but never seen, and in consequence of this contagious feeling the manager must stand as the personal representative of the corporation. The consumer must feel that the manager is human, that he is sympathetic, that he breathes the same air and is nourished by the same food as is the public, and that when a consumer approaches the manager he is transacting business with the corporation itself. To sooth the unhappy and bind up the wounds of the painful kicker is the manager's especial province. The public is prone to judge an institution by and through its employees, and praise or blame is directly due to the manner in which the consumer is treated. Courtesy is a cheap investment which results in big dividends. Failure to keep a promise made, forgetting or neglecting a request, will result in shaking the faith of the public in your desire to please, and confidence once destroyed is not easily restored.

Every customer obtained is an investment to the company, because it has cost something to get him, and as a general rule we can hold him if we accord him fair treatment. A consumer lost becomes an enemy of the business, and his influence with his friends and neighbors will work serious injury to the company. It has been our practice when a claim is made that a bill is too high to read the meter daily in the presence of the patron. He will soon learn to read it himself, and our observation has been that the man who understands his meter is never a kicker. If we find from these daily readings that he is not using as much gas or current as formerly, it is easy to convince him that he can get along with less than he has been accustomed to use. If he takes the position that he is using the same amount as formerly but was overcharged, he need only be told that the meter has not been changed, and since the meter has been registering less he must be using less. Do not try to convince a customer by your arguments that he is wrong and you are right, but prove it to him by the object lessons suggested. They are more convincing and have a more lasting effect. Customers have ideas sometimes as well as complaints, and I always respect their feelings and try to conform to their ideas when satisfying their complaints. Once in a while you will meet a refractory, obstinate, fault finder who will not be satisfied. I have been months convincing such a customer that we are gentlemen and regard him likewise. Always practice a kindly manner toward an irate customer, retain your self-control, and remember that before you can expect to control others you must first learn to control yourself. You will thus make a friend of one who was disposed to be your enemy and reward is certain to follow.

In this paper I want to call the especial attention of the members of the Association, and particularly the employees of corporations, to the fact that capital depends largely upon you for its success. The engineer may plan and the mechanic construct, but unless the man behind the counter, who is to meet and mingle with our patrons, can get business, and, after getting it, can hold it, capital is doomed to disappointment. Poor or interrupted service at times will be forgotten, but bad treatment never. Therefore, our employees are instructed never to talk back or be disrespectful, but to ever remember that "A soft answer turneth away wrath."

If the day is a little slow and the fog is rolling in and things are not going just up to standard; if you feel a little cross over your past for the many mistakes you have made, do not allow yourself to drift into a feeling that you are only an employee. At that moment you lose your individuality. Such thoughts slay ambition, discourage hope and leave us in the slough of despondency.

The public exact many trifling attentions from the lighting company, and when presenting themselves in their usual ruffled state of mind the manager has an opportunity to show his tact and diplomacy. As we are accused of being but the employees of heartless and soulless corporations, we are not supposed to have feelings, and we should hear their complaints with a concealed indifference, remembering that our occupation would soon dwindle into a narrow groove if it were not for the "kicker and his kicks."

The Practical Protection of Metal Surfaces in Gas Plants.

[A paper read by MR. L. P. LOWE, at the 11th Annual Meeting, Pacific Coast Gas Association, San Francisco, July 21–23.]

So much has been said and written on the protection and preservation of corrosive metal surfaces that a paper on this subject would seem to be almost superfluous in a gathering of engineers and practical men; but, in the best course of an extensive gas engineering and construction experience, the writer has met with so many inquiries as to what is really the coating for the practical preservation of metals in and around gas works that he is led to believe a discussion of the subject, setting forth some of the conclusions born of rather close study on these lines, may not be amiss, and while, in a general way, the conclusions reached apply to all of the engineering professions, it is the intention to, in this case, consider only the preservation of the metallic structures about the gas plants, which include buildings, machinery, gasholders, tanks, street mains, service pipes, etc.

The term "coating" broadly applies to all forms of covering, such as ordinary painting, dipping, galvanizing, tinning, oxidizing, etc., but as galvanizing, tinning and oxidizing processes are too expensive for general practical applications for gas works uses on a large scale, they may at once be eliminated in a consideration of this subject, in addition to which it is well known that they afford but an inferior protection at the best, and when used must themselves be protected by some form of paint.

Such coatings as galvanizing and tinning are, however, very useful and even necessary for the protection and longevity of very thin metals, such as roofing material, including corrugated iron, etc., in order to fill the pores due to the strains of manufacture in rolling such thin sheets, but notwithstanding the general impression that metal so coated is sufficiently well protected it is quite necessary to go the additional step of painting if durability is to be insured.

Painting, which includes dipping in asphaltic and like substances, is the only practical, satisfactory and economical means of accomplishing the work desired, and as "dipping" is confined to comparatively small articles, and at the best is but a nasty, slovenly and objectionable method of applying a protective coating, it is needless to consider it where good work is absolutely necessary.

We are all more or less familiar with the many paints offered for sale, some by simple, understandable names, while others are put forth under high sounding, mystifying titles, for which all manners of virtues are claimed; but how many of us ever take the trouble to investigate the genuine worth of even those whose names we can understand, to say nothing of the many others, and which, when tried, are usually purchased under a temporary mind aberration or hypnotic spell, produced by the pleasing volubility of a salesman whose tongue runs more oil per minute than is contained in his paint per train load. This condition would seem to indicate a sad lack of knowledge or case of neglect at the hands of a gas works' manager or engineer, but if for a moment we stop to consider that, in these days of rustling activity and keen com-

petition, it is far more necessary and of greater importance to have special rather than general skill and knowledge, it is quite evident that we must all rely upon one another to a greater or less degree, and hence it is that the dishonest and unscrupulous person can, for a time at least, impose upon his unwary and trusting brother.

If, during his experience in and around gas works, one has found a thoroughly satisfactory and durable time-tried paint or other coating for the preservation of the metal work under his charge, then let him stick to his paragon and wave all other suggestions to the winds; but, perchance, should there be some of us who, and I think most are, still searching for the best practical metal preserver, then it is hoped the following information and suggestions may be of assistance and value.

The patented paints, and those with high sounding trade names, should as a rule be avoided unless they are accompanied with a formula stating their composition. Some such are doubtless excellent paints for certain specified purposes, but when that is the case there can be no valid objection to their composition being known, as paint is something which does not at once show for itself nor until much damage may have resulted from its use.

Aside from these compounds, the paints suitable for use in and around gas works may be classed under the following heads, arranged alphabetically, the names of the pigments only being given in order to identify the different kinds: Asphalt, carbon, graphite, iron oxide, red lead, tar, white lead.

With the exception of asphalt and tar the above pigments must be mixed with a vehicle or carrier to form a paint, and it may be stated and accepted, without danger of valid contradiction, that a high grade and perfectly pure linseed oil is the only satisfactory article which can be used for this purpose if durability is to be insured, and if another equally good substance is in existence the writer is not familiar with it.

The linseed oil may be either raw or boiled. The former dries more slowly and usually requires the addition of a drier to admit of being worked within a reasonable time limit, while the latter or boiled oil may be said to be self-drying.

At the best human nature is but weak, and there seems to be no reason why even honest paint manufacturers should be an exception to this rule, and they may, for our present purpose at least, be excused for decrying the merits of the products of competitors in the effort to dispose of their own, so, aside from manufacturers' prejudices, it may be broadly said that all of the paints in the above list, when properly prepared and applied, are good; but some are better than others—much better, and this distinctly applies when they are used for the purpose under consideration—*i.e.*, the protection of iron and steel.

It is not the intention of the writer to enter into a scientific discussion of the relative merits of these paints, and, therefore, each will be only briefly considered save for that one deemed the best, and that will be treated at greater length.

Asphalt is a well-known mineral product. It forms the base of some crude oils from which it is recovered by distillation. If boiled until the volatile oils are driven off or nearly so, the resulting product, upon cooling, is hard and brittle and much resembles pitch. It is also found quite pure in a form resembling soft rubber, and in either state it can readily be converted into a good paint.

It is prepared for application, either as a cold or hot paint. If as cold paint the asphalt is dissolved in carbon bisulphide or some similar solvent, which dries very rapidly, leaving the asphalt as a coating. Other ingredients are perhaps added to increase the elasticity of this paint, but at best it is not of long life, as it is very apt to crack and peel off, and accumulations of gases arising from the paint are apt to cause bubbles. It may be applied either by dipping or brushing, the latter method always being preferred by the writer.

Asphalt paint applied hot affords a more elastic and better protective coating than when applied cold, as in its preparation it is left more in its natural condition. It is, however, quite necessary that all asphalt paints should be pure and free from acids to which they are liable and which affect metal surfaces. Such pure paint is difficult to obtain, in addition to which it may be said of all paints applied hot that they are liable to the annoyance of bubbling and blistering. It is as well troublesome to properly apply a hot paint, and all asphaltic coatings, if good, lasting and well applied, are necessarily expensive, and being very susceptible to extremes of heat and cold they require constant watching.

The pigments of the so-called "carbon" paints are usually lampblack (made from burning crude oil, resin or turpentine), "carbon black" (made from burning natural gas), or graphite. There is no more permanent paint pigment than carbon, but it is unfortunately so extremely light in weight as to make a paint having but little body, in addition to which it is well known that these carbon paints are all very slow driers unless mixed with a large amount of japan or other form of drier, which in excessive quantities is very injurious to any paint. As in the case of all other good paints, this pigment must be mixed with good linseed oil as a carrier, and, as the mixture is purely a mechanical one, the life of the paint is governed by the life of the oil. When that is gone, nothing remains but the dry, powdery pigment. What has been said of the carbon paints applies also to graphite paints. Graphite (commonly known as black lead) is a very pure form of carbon, and is obtained by mining or quarrying, depending upon its location. Two kinds are found, one known as amorphous graphite and the other as flake graphite. The particles of the amorphous graphite are irregular in shape and are said to make a better and more binding paint pigment than the flake variety. Be that as it may, it still remains a fact that paints of both kinds are mere mechanical mixtures of pigment and oil, and, as in the case of the carbon paints, their life is but the life of the oil.

Iron oxide is probably more generally used as a paint pigment for the preservation of metal than all other kinds combined, but its value is not in proportion to the large quantity used; but because it is well advertised, readily procurable, low in price, easily applied and pleasing in its rich brown color, it is logically popular. Being the great competitor it is soundly abused and attacked by the manufacturers of other dry pigments and mixed paints, but its record is not entirely a bad one and it has been of much use to mankind.

Iron oxide is found almost universally, and is obtained by mining. In its crude state it is usually in a hydrated condition, but before it can be safely used as a paint pigment it must be thoroughly converted to the dehydrated oxide. The carelessness of some manufacturers in attention to this all important detail and the ignorance of others have caused much trouble and damage from its use and have opened a wide inroad to the attacks of its enemies.

As in the case of the other pigments described above, iron oxide forms only a mechanical mixture with oil, and its life, too, is necessarily limited to the life of the oil.

Tar paint is usually made from the residual tar recovered in gas works. It may be either coal tar, oil tar, or wood tar, and what gas man is not familiar with it and has his own pet recipe for its preparation? There are doubtless many good ones, but they are all open to the same objections as asphalt paints, in addition to which tar paint is apt to contain a considerable amount of water unless expertly prepared with great care. Let it not be forgotten that where oil is the vehicle for carrying the pigments referred to above, pure linseed oil *only* will give satisfactory results. Animal oils, fish oils and mineral oils, though very largely used, are thoroughly unfit for the preparation of any form of a good metal paint, and their use is largely the cause of the failure of many otherwise good paints and their resulting condemnation.

All paint pigments, in addition to being pure, must be properly prepared and very finely ground to a powder, which, for commercial purposes should pass through a mesh of 250 to the inch. This is not all, as any honest manufacturer can insure purity, but there are other necessary qualifications which, however, are readily procurable if materials are purchased from manufacturers of good reputation and long experience. While the above paints may all be classed as good there can, of course, be but one best paint for metal, and the writer firmly believes that one to be red lead.

This is an oxide of lead produced by subjecting metallic or pig lead to a continuous heat in ovens or kilns, during which it gradually absorbs oxygen up to the required degree, it then being in the form of a fine, dry, red powder.

It has a strong affinity for linseed oil, and when mixed with it and allowed to set, a peculiarly hard, tenacious and elastic coating is produced, cementlike in its character, impervious to moisture and of great durability.

The reason for this is that, unlike all other pigments, red lead forms a chemical combination with linseed oil, which, when dry, is a cement coating of uniform and unchanging composition and not the mere mechanical mixture as in the case of the paints previously described.

The usual conditions are thus reversed. The pigment, instead of the oil, becomes a life giving factor, and as red lead is a very stable article, a paint properly prepared therefrom and well applied must necessarily be of long life, as it is not affected by moisture, ordinary acids, or alkalies to which it is apt to be subjected, nor by galvanic action.

Lest it be forgotten, let it be again stated that the red lead must be pure and very finely subdivided, and the oil must be pure linseed only. The necessity for this will be apparent when it is understood that linseed oil is to red lead what water is to Portland cement; *i.e.*, it serves to unite its particles. Time may dissipate the oil, but nothing except

abrasion or the wear and tear of the elements will ever remove the red lead cement.

When the combining and setting action of this paint is understood and appreciated it will be at once apparent that it can never be procured as a ready mixed paint, for if it remains in liquid form, even in sealed cans, it is a self-convicted, fraudulent and worthless mixture, and, *per contra*, if impure or improperly manufactured materials are used or adulterants added, the conversion to the cement form cannot fully take place.

While the superiority of red lead paint is now fairly well understood and admitted, there still exists some doubt and prejudice in the minds of many as to the claims made for it; but this is unquestionably because of unfortunate experience with paints supposed to be red lead, while in reality they were but spurious imitations, the writer himself having met with so many of these cases that he has come to be suspicious of the quality of both lead and oil unless purchased from reputable dealers in unbroken packages and bearing the brand of reliable manufacturers. This extreme caution cannot, of course, be observed where but a small amount of paint is needed, but generally speaking, the writer would not think of making purchases of these materials from stores in small towns unless quite familiar with the various brands, preferring to send, for even limited quantities, to the wholesalers in the larger cities who may be depended upon to furnish the articles called for.

Red lead paint is scarcely more expensive than any other kind of good paint, and its covering power, while possibly somewhat less, is not so much so as to make any practical difference. There are, however, considerations which should not enter into a decision as to a coating for the preservation of iron and steel, and especially in gas works, where so much of the plant, such as street mains and service connections, are permanently placed beyond the possibility of ready inspection.

Red lead paint may be applied with equal success upon all metal surfaces used in gas works construction, including gasholders, tanks, mains, services and structural work in general. Its preparation and application are, however, of vital importance, and while the manufacturers of red lead state that it can be mixed quite as readily as other kinds of paints, the writer feels that he must disagree with them upon this point. Proper mixing need not be a dreaded bugbear, however, for the oil and pigment can be intimately and smoothly mixed by simple stirring if necessary; but this method is a laborious one, and for this purpose it is much better to use a small revolving churn, or a regular paint grinding machine, the latter being preferred. Such machines are made in many sizes, but a small and inexpensive hand power one, costing about $4 or $5, is of ample size to quickly mix a large amount of paint, and a boy can easily do the work if provided with the materials and properly instructed.

Again, bear in mind that red lead paint "sets;" so see to it that the grinding machine is properly cleansed and free from paint before putting it away.

The scientific proportions for the mixing of this paint are said to be 33 pounds of lead to 1 gallon of oil; but a hard-and-fest rule is not necessary, it being simply requisite to introduce enough red lead to make a smooth, unstreaked coating, the quantity depending on the condition of the atmosphere, character of the work, skill of the painters, quality of the lead, etc.

It is useful to remember that 7½ pounds is usually considered a gallon of linseed oil, and that 24 pounds of red lead and 5½ pounds of linseed oil make about a gallon of paint, and while manufacturers state that 1 gallon should cover 1,000 square feet of plain, clean, metal surface, the experience of the writer is that a good, heavy coat, reasonably well brushed out, cannot be depended upon to cover more than about 800 square feet, but this is good work and gives a sufficiently cheap coating.

The natural color of this paint is a very bright and vivid red. It may, however, be shaded through a series of rich browns to a jet black by the mere addition of a small amount of lampblack. One-twelfth of an ounce of lampblack to the pound of lead will give a seal brown, a very pleasing and durable color for gasholders and the like, and one ounce of dry lampblack to the pound of lead, will give a jet black color to the paint. Observe caution in the use of lampblack, remembering that it is only a coloring matter and the least amount used to produce the desired color is the best. When dry lampblack is used it should first be mixed with the oil and the red lead be subsequently added.

Either raw or boiled linseed oil can be used. The raw is thought to be generally purer, while the boiled is claimed better to support the heavy particles of red lead. If raw oil is used a small amount of drier will cause more rapid setting and is said to furnish the same sustaining power for the red lead as does the boiled oil. The use of boiled oil and lead alone is the simpler method and is preferred by the writer, but it is necessary to know that the oil has been burned over a fire and not through the bunghole of barrel. That is to say, know that the oil has been actually boiled and not merely colored.

Red lead paint, being heavy and of great body, is applied with somewhat more difficulty than other forms of paint, and must be well brushed out to a thin, firm coating, else it will "sag" and "run."

Many gas managers seem to think that anyone can do a sufficiently good job of painting for gas works uses, and consequently employ the services of boys and unskilled laborers in the most important work of painting expensive metal structures. This practice should in general be severely condemned, for while some unskilled men may do fairly well, and all of them work conscientiously, the very secret of good work is still lacking in that the wrist muscles of boys and laborers are not developed as are those of the skilled painter who constantly uses them in the peculiar stroke called for in the application of paint by brushing. If there is but a small amount of work to be done almost anyone can manage it with care and proper instructions, but if the work is considerable then by all means employ painters to do the painting, as you would carpenters to do your carpentering, cooks to do your cooking and doctors to treat your disease. You will certainly pay more per diem to the painter, but in return therefor you will get an increased amount of work and, what is more important, a much better job. On metal surfaces, unlike wood, the first or priming coat should be the heaviest. On new work at least two coats should be applied, in which case the first should be lead and oil only, while the second can be colored as described to suit the taste. If the paint is left in its natural, vivid hue it may fade by a gradual transformation of the oxide into carbonate, but this does not impair its durability, as it is only a surface change and slight scraping will show that red lead beneath in its original color. The changing of the color of the second coat by the addition of lampblack has no advantage other than that of mere color harmony.

When the paint in its natural color is applied to the dark surface of the metal, the contrast is so striking as to at once show a dark spot should the painter by chance fail to fully coat the metal. If the second coat is colored to a pronouncedly darker shade than the first, a reversed condition exists, and failure to fully apply the second coat is indicated by the first light color coat showing through, thus making it more than unlikely that any portion of the metal will fail to receive the proper protection.

The addition of a certain amount of white lead to red lead paint will cause it to work more smoothly and easily, but for purposes of protection only all coats would better be red lead, and by all means let it be the first or priming coat; but if to fit color schemes, as in the case of building fronts and interiors, tinted paints are necessary, then the second and after coats may be of pure white lead and linseed oil, but provide a good foundation by first coating with red lead.

The proper preparation of metal surfaces before painting is highly important, and unless carefully looked after no coating can be satisfactory as a protection against corrosion If the metal could be cleaned to a bright surface it would afford the best resting place for the paint, but this is impracticable, expensive and unnecessary. All rust, loose scale, grease and dirt must be thoroughly removed.

Wire brushes with short, stiff teeth, and scrapers made from old files, will be found useful for this work. Rubbing with a piece of ordinary red or firebrick also does good work, and vibrations caused by sharp taps of a hammer will jar off much loose scale, while grease may be easily removed by washing with benzine. If deep rust marks are found from which oxidation cannot be removed by ordinary methods, common lamp oil (kerosene) may be allowed to soak in, after which the spot should be thoroughly "burned out," a convenient method being to use a painter's gasoline torch for the purpose. The kerosene is used for loosening the rust and aiding in heating same. It is burned out by the heat of the torch, which, if properly used, also roasts the rust, converting it from a hydrated to a dehydrated oxide, rendering it harmless and easily removed, in addition to which further oxidation of the metal is checked at that spot. All surfaces must be thoroughly dry before paint is applied to insure proper clinging of the paint, and kept as dry as possible while it is setting. Before a second coat is applied the first must be allowed to dry to insure good work.

Red lead paint sets quickly, and metal coated one day will be ready for a second application the day following. The material should, however, be painted and allowed to rest as long as possible before use. Like Portland cement, the setting process continues for a long time and will continue even under water, although, of course, much more slowly than when exposed to the air. The very best paint imaginable is valueless if disturbed after its application, and as a chain is only as strong as

its weakest link, so is a metal surface only protected to the extent of its poorest coating.

The writer has seen thoroughly painted pipes carefully loaded on trucks, and subsequently dragged from the tail end by a burly teamster in such a manner as to remove a narrow strip of coating along the entire length of pipe. No coating will stand this rough treatment, which can be avoided by furnishing a sufficient force to properly handle pipes without damage, but should abrasions accidentally occur they should always be touched up ere the work is left or hidden from sight, and tool marks should receive the same treatment.

Probably no other structure around a gas plant should be given the best and yet receives the poorest protection than does the all important and vital gasholder. Its original paint soon falls from its neglected crown, sides and frame, it groans and creaks dismally and yet serenely bobs up and down by day and night through years of usefulness.

With a new holder the fault generally lies with the builder upon whom the overburdened gas man depends and whose specifications usually read about as follows: "All metal work will receive a shop coat of paint before shipment, and a finishing coat after erection."

That means any old thing, and that is exactly what is given. Why not specify a shop coat of red lead and linseed oil, of approved brands, properly applied in natural color by skilled painters before shipment, and a finishing coat of the same material, colored to a pleasing brown and properly applied after erection. The great engineering professions are beginning to realize the fact that painting specifications for metal coatings cannot be too full, complete nor carefully drawn, and gas engineers must do likewise.

For the benefit of those not familiar with the method in use of painting gasholders, the writer will explain that it is his practice to, as thoroughly as possible, remove the old, loose paint, beginning with the center crown sheet, and alternately cleaning and painting each course of sheets until the crown is completed. The side sheets are best cleaned and painted by beginning at the bottom and working towards the top, course by course. At the best the bottom sheets will receive but an indifferent coating, but by taking advantage of the times when the holder is full of gas, the cleaning and painting of even these sheets can be fairly well done.

As an instance of the preserving qualities of red lead the following interesting incident came under the personal notice of the writer during his one time residence in Philadelphia. A wholesale examination of gas service connections was being made, and those which had been in the ground about 20 years were being replaced. It was an extensive piece of work and afforded ample opportunity for observation and study. The pipes were principally of wrought iron and had evidently been laid without coatings of any kind, and while some were still in a fair, and even good, state of preservation after 20 years' use, many were scarcely more than "a streak of rust and right-of-way."

One day, while inspecting a very much pitted and rust eaten section of pipe which had just been removed from the trench, it was noticed that a space of several inches along one side seemed quite sound. To determine the reason the clinging earth was scraped away, when there appeared a paint having the characteristic color of red lead, and there has never been the slightest doubt in the mind of the writer but that it was an unintentional coating given by a workman who had evidently brushed on the paint in cleaning the tool he was using in putting red lead luting on the pipe threads.

The paint was hard and firm, and the metal immediately beneath seemed to be excellently preserved and in as good condition as when first laid.

Shipbuilders have come to fully realize the value of red lead and linseed oil as a paint, and almost no other form of coating is applied to ships bottoms where the very best possible protection is imperatively demanded, and where wear and tear is probably more severe than under almost any other condition. In conclusion a brief consideration of the chemical properties of red lead will be of interest to some, and a final word of caution may not be amiss.

Lead forms three distinct compounds of oxygen, namely: Lead suboxide, Pb_2O; lead oxide, PbO; and lead peroxide, PbO_2. Red lead, or minium, has the composition Pb_3O_4. Lead oxide, PbO, is commercially known by the name of litharge. It is formed by the oxidation of molten lead in contact with air. When litharge is heated in the air to 900° F. it takes up oxygen and is converted into minium, or red lead, Pb_3O_4 ($2\,PbO + PbO_2$).

There are many substitutes on the market for red lead paint, and much low grade and adulterated red lead is sold. The architect or engineer, before writing his specifications, should acquaint himself with the purity and fineness of the different brands manufactured and specify, by name, the kind desired, as a specification calling simply for "red lead" may mean, so far as the inspector is concerned (as he has no ready means at hand of telling), a lead oxide that contains anywhere from 30 per cent. to 50 per cent. litharge (PbO), which he has to accept as red lead if it is to simply pass the blowpipe test. This may be "pure lead" but not pure red lead, as it has not been properly fired, or, in other words, has not received the highest form of oxidation, which is essential in order that it may have the proper affinity for linseed oil, which it will "take up" in its "set" after application to the metal, as explained above.

The amount of linseed oil which the red lead will take up in setting is 25 per cent. of its own weight, which gives a cement coating composed of 82 per cent. pigment and 18 per cent. oil. Oil in excess of this amount will cause the paint to streak and run on the surface of metal.

The simple formula of 33 pounds of red lead to one gallon of 7½ pounds of pure linseed oil, is based on a scientific fact and must be followed in order to obtain the best possible results.

Pure red lead cannot be mixed with linseed oil and shipped any great distance or kept any length of time without "setting" in the package, so beware of all ready mixed red lead or red lead paste, as any substance, liquid or solid, that will hold red lead in suspension in the package will prevent it from taking the proper "set" after being applied.

The moral is, select your own materials and mix only as wanted.

Present Conditions in the Anthracite Coal Regions.*

During a recent trip in the anthracite coal regions the afternoon found the miners' cottages as silent as a Brooklyn side street on any workday afternoon, save that here and there there was a jaded miner returning from his work, with dirty smoked cap on head, his whole appearance being that of the "great unwashed." Although there are washing facilities at the mines, the men prefer to postpone their ablutions until they reach home. The foreign element predominates, and I am informed upon good authority that they have here housing accommodations immensely superior to those in Europe.

Life among the miners does not strike one as being a life of progress. We find them fairly intelligent, but with no hurrying desire to improve their lot. There are plenty of well-frequented saloons in Scranton, for instance; but the very select public library, open till 9 P.M. to all, has a scant attendance. The homes of the miners' men—that is, the men employed and paid by the miner out of his own pocket—are very poor. Many of them have a woebegone appearance, consisting of only 2 or 3 rooms and kitchen, with a bit of garden, often neglected. The wooden coal bin is unpicturesquely placed right in front of the shanty-like house. This is done for convenience sake, because the coal is brought along the dirt road, and there is no cellar. Miners and workers alike buy their house coal, a ton at a time, direct from the employing company. That is socialism, pure and simple, in one form, and it is all of sociology they have at present. If they get an 8-hour day in the days to come that will be another move in the same direction. At present, indeed, the 9-hour day is only nominal, since the numerous holidays more than clip off that one odd hour in the aggregate. Strike or no strike, many miners borrow money on their homes, just to "keep up a little style," and thus have the curse of their debt hovering over their modest homes, with legal interest to pay. One of them said he was "obliged to make a little appearance" and entertain visitors, or "what would they think of me?"

The piping times of peace and plenty are observable all over the coal regions. In the towns, big and small, there are no idlers loitering about—everybody appears to have something to do about the mines. The late strike stockade is still up, and is to be allowed to remain. It is surmounted by a double line of barbed wire. This is a country of barbed wire fences. The farmers thought they had found in them a panacea for keeping out tramps and boys.. Instead, on the contrary, they caused more injury than smooth wires; for, with the latter, trespassers would slip through and leave them intact, now, with the barbed wire, the delinquent's pocket knife is provided with a strong wire cutter, which clips the barbed wire as a beaver's tooth pierces hemlock. Thus the farmer has a few yards of fence ruined here and there. These barbed wire fences, in fact, gave an impetus to the sale of handy wire cutting tools at country stores. So we see how a supposed advantage in barbed wire fences is counteracted by an increased sale of small hardware for the surreptitious cutting thereof.

The Slav mine worker is a peculiar person, but his Pennsylvania home is about on a par with those in his own Slav countries. But his own native homes, made up as they are of entire tree trunks, mortised, are much better fitted for keeping out the cold in winter than the ½-inch

* *Iron Age.*

American planking. Many of the Slav mine workers, from motives of economy, house together a dozen in a room.

Life amid the darkness of the mines becomes second nature to the toilers. One miner who thought to do better as a farmer tried it for a year, spent all his little savings, and, finding himself poorer, preferred to return to the mines. Why, he was asked. Because every fortnight there was some cash to see—steady, sure wages; whereas after a year of land culture he received nothing.

To the visitor the tremendous amount of labor involved in the mining and preparation of anthracite leads to the idea that the coal is too cheap. At the top of the breaker there are full grown men directing the huge coal as it comes down the chute from the car just tilted. This is unskilled labor, but men must be employed; boys would scarce be strong enough for the work. Now these men only receive $1.50 per diem of 9 hours, but perhaps that is no harder work than that of the men in the subway trench at the same rate of pay.

Summit Hill is the highest, cleanest and prettiest coal mining village in the anthracite regions. The altitude is 1,660 feet or thereabouts. The roads are the pure, unstained whitish gravel, and there are no culm heaps or anything else higher up to be washed down by the rains. The houses are bright and clean—in fact, the whole place is the best illustration yet seen of a certain soap advertised "Spotless Town."

In the coal region the disposal of articles made from coal is a minor industry of some importance; manufactured into paper weights, candlesticks, etc., is is sold at about 50 cents a pound, or at the rate of $1,000 a ton. A rather ingenious fraud in the coal curiosity line was exposed at Summit Hill. There are offered for sale at some stationers' and jewelers' shops in the mining towns miniature *fac-similes* about 4 x 5, of breakers. Apply a match to a corner of this model piece of "coal," and lo, it instanter begins to melt and run. It is nothing but a black wax composition—common mineral wax and lampblack. Some ingenious Yankee had at one time bought a real coal breaker miniature, and promply saw how he could make a plaster cast of it and reproduce it in black wax *ad infinitum*.

At Tamaqua the mines were closed for the day, and the miners and mine workers had donned their best, standing about the corners conversing and idling. Very few busy themselves on self-improvement. Any occupation would be better than loafing around street corners.

During the strike a story was sent out of men compelled to sleep below in the mine stables, but it was entirely by choice and not by necessity that the Slavs did so. They did it to save money. The stables are all right—well ventilated, scarcely any objectionable odor, warm in winter and cool in summer—but of course everything is in pitch black darkness always, save for the smoky flare of the miner's lamp or (in the more progressive mines) the 8 or 9 glow lamps. But the black roof and walls so instantly absorb the light from the electric bulbs that at a little distance they look like dull, yellowish red pear shapes, and their light penetrating efficiency is reduced from 16-candle power to about half.

Every mine has its temporary hospital down below—a room cut in the rock, slate or coal, provided with stretchers or cots, tables, lights always burning, turned low, and a telephone for summoning professional assistance. Some of the hospital rooms have the appearance of being so well used that it looks as if accident cases must be brought in every half hour. But nothing of the sort. The mine workers use the hospital as a sort of parlor and are not averse to holding a little conviviality there.

Shenandoah was the seat of war for a long time last year. It is among the least inviting mining sections and towns visited. Ugly nondescript houses, wretched streets—there seems to be not a whit of municipal pride about the place. A town without a showing of municipal pride is in a poor way. There is material right at hand to make Roman roads that might last 2,000 years without repair. Coal ash and *débris* is in hill lots about the region, and would, properly rolled down, make excellent roads, mixed and atop of the present clayey, miry streets of Shenandoah.

The sentiment probably occurs speedily to the casual visitor to the anthracite coal fields that operators should treat in a liberal spirit any demand of the mine workers for an increase in compensation, because of the fact that much of the work involves arduous labor; and yet the fact must not be lost sight of that, as compared with other lines of employment equally wearying and arduous, their compensation is regarded by some as fairly liberal, and that the damp and darkness of the mines (which have such an effect upon the chance observer) have no terrors for the mine workers. They get used to it, and prefer work inside the mine to work on the surface, because, for one thing, of the equal temperature throughout the year—no blizzards and no sunstrokes a thousand feet underground—and also because of the usually enhanced pay.

According to the local bankers nearly 75 per cent. of the extra payments received under the Gray Commission award has been put on deposit by the miners, the foreigners especially banking their money. The storekeepers say that most of the miners have paid the bills which they ran up during the strike and that business is good. "The month of June," said a large retailer in Scranton, "was the best we have experienced in 3 years, and the same can be said of every merchant in the region. The miners have also had a good month, and we hope that they will continue to work steadily for some time to come."

The amount of labor involved in the production of marketable anthracite, after it leaves the mines, is what astonishes the observing visitor. There are the costly giant breakers to build, equipped with complex mammoth machinery, which costs a fortune in itself. Literally every pound of coal, after going through the breaker, passes under the eyes of a small contingent of sorters or pickers on its downward journey. Of course, thousands of pounds soon slide under the eyes of a couple of workers, but not too fast for them to do their work of sorting. But who, among outsiders, would think that so much trouble was taken with coal we often carelessly burn by the ton? It is almost unbelievable—that remark about "every pound of coal" passing under observation. The term "manufactured coal" has been applied to this anthracite over which so much care is exercised.

From different tradesmen it was learned that some mine workers, who had, at the tether end of last year's voluntary idleness, run into debt, had not displayed the same eagerness to rush in and pay their back debts as they had displayed in lining up at the mines to receive their back pay. Some of it went into the banks and some was sent abroad. There are exceptions to every rule, and the percentages change with the character of the mining population, whether it be Anglo or Slav.

Insurance Inspection.[1]

The introduction of complicated apparatus as a means of protection against fire and the use of hazardous materials in manufacturing processes have made it necessary for proper and careful inspection, and the result has been the formation of bureaus having for their special object the proper and systematic supervision of factory risks. The inspector can be consulted at any time upon any and all subjects relating to fire appliances, hazards in machinery and special hazards in the manufacturing process. Among them I note the installation of automatic sprinklers, yard hydrant and pump service, installation of many of the various gas machines for light or power, installation of a thermostat or automatic electric alarm system, installation of an electric system for light or power and devices for safely handling gasoline, naphtha, rubber cement, celluloid, japans, lacquers and other compounds. The testing of such other materials as might endanger property with a view to their proper care and safe handling, and the readiness with which the manufacturers generally accept the conclusion of the inspector, are evidence that the inspection bureaus have their confidence.

In considering the matter of fire protection a complete and modern system of automatic sprinklers has been found to be the most efficient in preventing the spread of fire. But sprinklers to be effective should be placed throughout the premises, including basements, lofts, under stairs, inside elevator wells, in belt, pipe, gear and pulley boxes, and in small inclosures such as drying rooms, heating boxes, chutes, conveyors and closets. Experience has taught the inspector that sprinklers are often necessary where seemingly least needed. Their protection is required not alone where a fire may begin, but also wherever any fire might extend, including wet or damp locations; but if buildings have air spaces in partitions and ceilings and vertical drafts without cut off, fire may originate in such a way and spread in such a manner that the heat would generate water into steam so rapidly as to cause a total destruction of the property.

Experience has also taught us that, owing to the negligence of employees who are responsible for the care of the equipment, post indicator valves outside of a building where they can be frequently observed are an essential feature for safety, and in a plant where such places cannot be heated the installation of a dry pipe equipment should be required. Considering that the sprinklers fuse at a temperature of 155° F., the inspector must know of the location of the processes relative to the heat used, and promptly inform the assured of any change in sprinklers made necessary by the change in location of the

1. By Mr. James H. L. Coon, Inspector, Watertown, Mass., before the New England Foundrymen's Association, Boston.

manufacturing processes, for the inspectors endeavor to keep correct records and plans of all manufacturing plants under their supervision. It is therefore of the utmost importance, as a matter of economy and safety, that no change be made in construction or of sprinkler piping without consulting with the inspector, whose services can be procured upon application and without cost to the manufacturer.

In many cases sprinklers have been a failure, for, by reason of imperfect equipment, an explosion may cause a fire too intense to be subdued. Fire occurring in an unsprinkled part of a plant may result in the total destruction of the property. A fire originating in an unprotected belt or stair tower might result in the total destruction of the property. Fires have occurred about hot boxes and spread so rapidly as not to be subdued by sprinklers. In many cases fires have originated in closets and unprotected places which have been promptly checked when reaching sprinklers. Blower systems in operation near where a fire originates spread sparks to all parts of plant. Lack of proper care in keeping automatic hatches and stair doors in order have resulted in the rapid spread of fire and heavy loss before the fire would be checked by sprinklers. The lime washing or painting of sprinklers has resulted in heavy losses for this reason of neglect. Fire pumps improperly connected with boilers have resulted in disastrous fires. In my experience I have found sprinkler pipes choked with stones which have worked their way in from the public lines. Sprinklers have been maliciously removed, the openings plugged, and the sprinklers returned to their proper place, pipes disconnected and put together by flanges with rubber packing, which covered the whole opening, thus preventing circulation, and many removed, thus injuring the equipment. Sprinklers that I have found inoperative by reason of valves at risers being closed have been numerous, and equipments cut off by valves partially closed for the reason of the mistaken idea that closing a valve would reduce the water pressure.

In the matter of hazards nitric acid causes much trouble. Lately such acid has been packed in cork, but when packed in the carboy with hay, leaks or breakages result in fire. The storage of acids and ammonia in large quantities in factories is discouraged, not because the latter is dangerous as a fire hazard, but because of the stifling nature of the liquids, thus preventing the entrance to buildings by firemen in case of fire. Benzine, the most dangerous of the liquids in common use and largely used in various processes, has been the cause of many fires. A given volume in liquid form is capable of conversion into sufficient vapor 8,500 times the volume of atmospheric air, and this inflammable atmosphere coming in contact with an open light will convey flame a long distance from its source. In all places where this liquid is used care should be taken that no flame for lighting is used, and if electric lighted, no lamp to be fused or cut out should be allowed in the room.

Naphtha and other products of petroleum, evaporating at a low temperature, are exceedingly dangerous to have inside of a factory. The gas mixed with air forms a heavy vapor, which in a cold room will lie undetected near the floor, and coming in contact with a flame cause an explosion. Lacquers used in metal working establishments having a low flash point have been the cause of many fires. The lower the flash point the more likely is the atmosphere to be impregnated with the inflammable vapor liberated by the heat of the room. These are found under the names of enameloid, zapor, branoline, krystaline, obelisk, lastina, pyramid, adamantine, albaline, colophite, having a flash point varying from 18 to 116° F.

Damp lampblack will ignite from the sun's rays. The same can be said of cotton waste moist with lard or other animal oil. Lampblack and a little oil or water will, under certain conditions, ignite spontaneously. Nitric acid and charcoal create spontaneous combustion. New printers' ink on paper, when in contact with a hot steam pipe, will ignite quickly. Boiled linseed oil and turpentine in equal parts on cotton or linen rags or cotton waste will ignite in a few hours under a mild heat, and will in time create enough heat to ignite spontaneously. Bituminous coal should not be stored where it will come in contact with wooden partitions or columns or against warm boiler settings or steam pipes. This coal should not be very deep if it is to be kept on storage for a long period. If piled in the basement of a building it should be shallow and free from moisture, and under good ventilation. That liable to absorb moisture should be burned first. If on fire a small quantity of water showered on this kind of coal cokes it upon the top and retards any great supply of water reaching the fire, thus necessitating the overhauling of the pile.

Iron chips, filings or turnings should not be stored in a shop in wooden boxes. The oily waste which is not infrequently thrown among them adds to the danger of fire from this source. The sweepings from the machine shop, if kept on hand, should never be placed over iron shavings. This mass of disintegrated iron is enough to incite heat and combustion Iron and steel filings and turnings when mixed with oil will ignite spontaneously after becoming damp. A steam pipe against wood will cause the latter to ignite spontaneously after being carbonized, particularly if superheated steam enters the pipe, thus increasing the heat temperature. Steam heat apart from its contact with water forms a gas.

Persistent watchfulness being the greatest safeguard against the breaking out of fires, it is important that in a manufacturing or other large establishment a system of periodical inspections be carried out by the manager and a regular inspection by a competent man, one who is likely to persevere in its supervision. With most men immunity from fire occasions a feeling of security and consequently after a few months of careful attention to duty men fall into negligent and prefunctory habits. A daily inspection is not too frequent and will pay for itself ultimately. Every part of the premises should be looked after, particular attention being given to the following:

1. The line of every steam pipe should be carefully followed and it should be ascertained that no part of it is in contact with wood, and that no cotton waste or other inflammable substance is near it.

2. The surrounding of every steam boiler, stove or other heating apparatus should be examined, all inflammable material removed from the vicinity and defects in smoke flues or flue connections or supports should be noted and reported.

3. The open space beneath benches, tables and wide shelves and in inclosed belt boxes should be examined for inflammable materials and the same removed, and the attention of any person responsible for leaving such material in dangerous position be called to the matter.

4. All places where oils, varnish, lacquers, japans or naphtha, etc., are used or stored should be particularly examined and every precaution taken against fire. Special care should be taken against leakage of these inflammable materials, to see if any cotton waste or rags or other substances liable to combustible ignition when fouled with oil have been left lying outside of their proper receptacle. The condition of the yard should have attention and no accumulation of inflammable materials should be allowed against buildings.

5. A careful examination of fire equipments should be made. Every part of the apparatus should be examined and anything whatever missing should be promptly reported; also, that all valves are properly secured open and that all elevator hatches and stationary doors are in good condition.

These notes are general in their application, but every establishment is liable to some special risk belonging to its class, and the inspector's attention assigned to this work should be called to any special hazard pertaining to the manufacturing processes. Upon the conclusion of each report the inspector should fill out a blank provided for the purpose, giving particulars of the state of the establishment and submit such report to the manager.

The Possibilities of Future Economies in Electrical Illumination.

[Taken from a paper read by MR. W. A. CHAMAN, Engineer City Electric Plant, Glasgow, Scotland, at the Sunderland Meeting of the Municipal Electrical Association.]

The question of possible future economies in electric illumination is one of very considerable importance. There is hardly need to point out that if the economy is brought about by consuming a smaller amount of energy to produce a given amount of light, the ultimate result is not a reduction of revenue to the undertaking but an increase, owing to the larger number of consumers who adopt electric light in preference to the older means of illumination, as well as to the more generous use of it by existing consumers.

There is also another advantage to the undertaking in the reduction of the proportion which the peak lighting load bears to power or other day load, though it may be some time before this becomes noticeable.

The subject of possible economies in illumination, however, covers a wider field than the saving in consumption of energy, for any reduction which can be made in the cost of maintenance of the lamps, and particularly in the trimming and attendance on arc lamps, may come within the scope of this paper.

No doubt the question of cost of production of energy also might fairly be treated as part of the subject, but it is not proposed now to deal with that matter at all.

Our attention is naturally drawn first to the ordinary incandescent lamp as we know it to-day and have known it for some years past. Is there any probability that the carbon filament is capable of being worked, with satisfaction as to its lasting properties, at any materially higher efficiency than the 3½ to 4½ watts per candle power, to which we are accustomed? The outlook in this direction does not seem very encouraging, though some 8-candle power 250-volt lamps recently tested

in Glasgow have started with an efficiency of 3½ watts per candle, while, after 600 hours of burning, the efficiency has not gone below 4½ watts per candle, thus showing that this degree of efficiency is not confined to lamps of 16-candle power or over.

Some 12 months or more ago an incandescent lamp bearing the name of "Crawford-Voelker" was brought out, having a filament alleged to be made of some carbide and promising considerable improvement in efficiency as well as long life. As, however, nothing has been heard of this lamp for some time it must be assumed that some difficulties have arisen in its manufacture which have so far prevented its coming into the market.

The next lamp to claim our attention is a departure from the ordinary filament in vacuum. It is the now fairly well known Nernst lamp. In Glasgow alone it is stated that there are about 10,000 of these lamps in use in ordinary customers' premises. A large number of them have been in use in Buckingham Palace for some 13 months past and have given great satisfaction, having reduced the consumption of current by about 50 per cent. The large clock at the houses of Parliament has also now been lighted by Nernst lamps, and very satisfactory starts have been made in its adoption for street lighting at Maidstone, Barking, Barnes, Colchester, Gravesend, Erith and Brighton, and experiments in this direction have been in progress in Glasgow for over six months past. Indeed it is a question whether the Nernst lamp should be classed as a possibility of the future or not rather a realization of the present time.

The results of recent experience from several different sources show that an average life of 600 hours is by no means too much to expect, and doubtless this figure will be improved upon as time goes on. As regards economy, the claim put forward is that, light for light, the Nernst lamp consumes about half the energy consumed by the ordinary carbon filament incandescent lamp.

The fact that the filament requires heating before it will conduct the current, an operation requiring about half a minute, is against the Nernst lamp to some extent, but in many cases it is of no real consequence.

It is, so far, not made in very small sizes, the smallest absorbing one quarter of an ampere (which equals, at 250 volts pressure, about as much energy as is consumed by one ordinary 16-candle power lamp) but giving a light of fully 32-candle power. This is too large a unit of light for ordinary domestic use, and, combined with the last named disadvantage of not lighting immediately when switched on, is perhaps the reason why it has not found its way to a larger extent into private houses. For perfection of lighting, however in a large room, a 1-ampere lamp fixed near the ceiling with a nearly opaque shade beneath it, so that nearly all the light is reflected off the ceiling, is hard to beat.

It is not within the scope of this paper to discuss the details of manufacture of any lamp, but one cannot help remarking that as substances are evidently known which will give off a brilliant light when heated to a moderate extent, as in the incandescent gas mantle and the Nernst lamp, there is no apparent reason why some combination of carbon filament with one or other of these materials should not be evolved which will combine the advantage of instantaneous lighting with that of high efficiency. This, however, is no new idea, as many inventors are said to have been at work taking out patents for various combinations. Perhaps a little more work in the laboratory and a little less at the patents might have produced the result we are now awaiting.

The "Meriden" lamp which is apparently being made by the General Electric Company of America, may be a step in this direction, though no information as to the composition of its filament is at present available. It seems only to be made in one size of 55-candle power, and the efficiency claimed for it is a consumption of about 2 watts per candle. No lamps can, however, be obtained to experiment with, up to the time of writing this paper.

In passing away from filament lamps our attention is first attracted by the Hewitt mercury vapor lamp, which is now well known by repute to most electrical engineers, but which has been seen, perhaps, by comparatively few. It consists of a glass tube about 1 inch in diameter and some 3 or 4 feet long, having a bulb at the bottom containing mercury and an iron electrode at the top. The tube is hermetically sealed and the air is exhausted to a considerable degree. The electric current is passed through the tube from the electrode at the top, which is connected to the positive pole of the circuit, to the mercury in the bottom. The working pressure for a tube some 3 or 4 feet in length is about 100 volts, but a much higher pressure is required to start it. This is produced by the insertion of a simple self-induction coil connected in the lamp circuit and coupled up with a switch in such a way that the tube can be momentarily short circuited, thus putting the coil direct on to the 100 volts pressure. On breaking this switch the kick or extra e.m.f. produced by the coil forces a passage through the tube, starting the mercury into a vapor, and immediately a steady current commences to flow. The light at first is tinged with purple, but as the tube warms up it becomes whiter. The peculiarity of the light itself is that there are no red rays in it, and its effect upon the beauty of a rosy complexion is disastrous. This cannot, of course, be set right by making the tube of red glass. A plate of red glass, which will let through floods of red light from a ray of sunshine, acts almost like a total eclipse when applied to the Hewitt lamp.

Here, again, however, it would seem possible by means of combination, that is to say, by mixing something with the mercury, to produce light of a different character, having red rays in it, which would remove this one objection. Even as it is, it could be used for street lighting and similar purposes with great advantage, for its economy is of a high order, the consumption of energy being about half a watt per candle power, or about the same as that of the ordinary open type arc lamp. It is claimed that the lamp can be made in any size from a tube ¼ inch in diameter and 3 inches in length to 3 inches in diameter and 12 feet in length, while the range of illumination may vary from 16-candle power to several thousands, according to the size of the tube. Voltage seems to present no difficulty, as lamps can be made to work at any pressure from 50 to 500 volts. A peculiarity of the lamp, apart from its light, is that the current will only pass through it in one direction, viz., from the iron to the mercury (if we are right in saying that the current flows out along the positive wire and back the negative). Alternating current will not pass through the lamp, and a modification of it is made, called the "Hewitt static converter," which will let through only those waves of alternating current which are above or below the zero line, as the case may be. This recalls to one's mind the amusing remark made by Mr. Mordey some years ago, that "one of the great advantages of alternating current was the impossibility of using accumulators with it." The Hewitt lamp seems to have a great future before it. One cannot but feel that the absence of red rays is an objection that will be overcome. Its economy leaves little to be desired if it can be maintained in small sizes, and its length of life seems to know no limit, except that after every 1,200 or 1,400 hours of use the tube requires opening and washing out. It is then, when re-exhausted, as good as new.

Turning our attention now to arc lamps, we find by mixing various substances with the carbon during the process of manufacture that it becomes possible to completely alter the nature of the electric arc flowing between carbon points as we have known it hitherto. The arc, for instance, in the Bremer and other arc lamps of the "flame" type is much prolonged, and the light can be colored with various tints, the most common and, probably, the most satisfactory being yellow, somewhat approaching orange. Instead of the light being almost entirely emitted from the crater of the positive carbon, it now peoceeds from the carbon particles or vapor forming the arc itself, which in many respects resembles a gas flame, as the name given to this type of arc lamp implies. The efficiency of the light is also very largely increased, for instead of the consumption of half a watt per candle, which is usually obtained with the ordinary 10-ampere arc lamp of the open type, it is now reduced to about a quarter of a watt per candle.

There are, however, still some objections and difficulties to be overcome before this type of lamp can come into general use for street lighting. First, the consumption of carbon is very much greater than with the ordinary type of arc lamp, thus necessitating trimming at more frequent intervals. Second, the light is not so steady as that of the ordinary arc, having a continual quiver rather like a badly burning gas flame. Third, it does not seem to have been possible so far to produce a satisfactory burning lamp which will give the same candle power as the present 10-ampere lamp with a consumption of only half the energy. All that has been brought about seems to be the doubling of the light without altering the present consumption of energy, and this is hardly what is required in ordinary street lighting. The light given by an ordinary open arc of 10 amperes (which one may take as being in round figures 1,000-candle power) is a sufficiently large unit for almost any class of street lighting and in many cases a 7½-ampere lamp is ample for the purpose. One cannot but feel, however, that all these difficulties will in one way or another disappear as time goes on and as various further improvements are developed.

Another departure in arc lighting is worth our attention, viz., the "Very Small Current" arc lamp, consuming about 1 ampere and burning either with an inclosed or an open arc. That an arc can be maintained with so small a current with a fair degree of satisfaction seems to be beyond doubt, and the only question is whether in actual cost of

maintenance it will prove cheaper than the Nernst lamp or the Mercury Vapor lamp. No actual experience appears to have yet been gained regarding the cost of maintaining these small lamps for long hours of burning, but it does not seem probable that they can do better than the Nernst lamp when one takes into account the cost of retrimming, etc. The inclosed arc lamp can scarcely be dealt with as a possible source of future economy, it having been for some years past a recognized and readily obtained marketable article. Beyond the fact that it increases the hours of burning without retrimming, there is not much to be said for it, as it certainly does not appear to reduce the consumption of energy per candle power as compared with the ordinary arc. It has done considerable good, however, by spurring on the makers of the ordinary open type arc lamp to produce lamps which will burn longer hours without retrimming, this being brought about by simply increasing the length of carbon which a lamp can take at one filling.

In some towns raising and lowering gear is used upon the arc lamp posts, the object being to enable one man, *i.e.*, the trimmer only, to go his round without the assistance of a mate to help him with the ladder. Whether there is any real economy brought about by the introduction of this hoisting gear is not quite clear. It obviously depends upon the original cost of the hoisting gear and the annual cost of its maintenance. Those engineers who have to deal with large numbers of arc lamps in big cities will doubtless feel more comfortable in their minds if they adhere to the fixed suspension arrangement which is mostly in use, as the risk of accidents in large cities is beyond question far greater than in provincial towns.

It may be reckoned that the saving of labor by the adoption of 60-hour instead of 40-hour lamps would be about 11s. per lamp per annum, and in places where the number of arc lamps approaches 1,000 or may be considerably more, this is a saving which amounts to a considerable total in the year. The possibilities of economy in the use of the ordinary arc lamp for street lighting do not therefore appear to be yet exhausted.

To summarize, therefore, briefly the results of our inquiries, it may surely be stated without much stretch of imagination that the possibilities of future economies in electric illumination for all purposes are considerable, and even that we may hope to see the consumption of energy for a given amount of light cut down by something approaching one-half of the present figure, besides reaping the benefits of other economies of maintenance, at any rate as regards street lighting.

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

A Criticism.

YONKERS, NEW YORK, August 17th, 1903.

To the Editors AMERICAN GAS LIGHT JOURNAL—I have read with considerable interest the article in your issue of August 10th, entitled, "Water Gas Manufacture by the Kramer and Aarts Process," and also a description of the so-called Lewes process in the "Progressive Age," which seem to afford material for a joint criticism.

My first impression of the two articles was one of surprise that the respective writers should have exhibited such apparent unfamiliarity on subjects which as gas engineers they should have been familiar with, and which have been before the American public for many years.

The question of substituting a low candle power gas with high flame temperature for the prevailing illuminating gas is a subject that will in a short time occupy the attention of gas engineers all over this country and Europe, and there is little doubt but that the result will be the general adoption of such a gas, consisting of a body of blue water gas enriched by a suitable amount of cannel, or coal gas, or oil, as local conditions may advise. In working for this end, however, it is certainly unwise in these piping times to assume a premise which does not consider the work of a generation of capable gas engineers.

Referring, first, to the Kramer-Aarts process, it is well known that several manufacturers have for years been selling apparatus for carrying out the general idea of the process, and at least one of these forms is identical with the system described as the Kramer-Aarts process.

This apparatus involves a pair of generators working precisely as described in the article, save for a down air draft, which permits of the utilization of the producer gas made during the blow, a point which was apparently not anticipated in the Kramer-Aarts process.

It may be of interest to the latter people to know that these American generators use bituminous or anthracite coal, coke or wood, and a thermal efficiency in regular operation of 86 per cent. is common.

The operation described as the Lewes process dates back to a time 16 years or more before the general adoption of carburetted water gas. The writer has in mind at least one company which for years passed a small amount of water gas through the retorts during the distillation to reclaim condensable hydrocarbons in the tar.

The water gas was generated in the two lower retorts of the setting by passing a small amount of steam, oil and air through an iron pipe in the retorts. The gases thus generated pass up through the rear of these retorts and through the upper retorts in which coal gas was being made and out in the regular way. The result was a clean, rich gas of much higher candle power than the coal gas, but no claims were made for increased yield aside from the gas added by the steam and oil. This operation, however, was given up upon the advent of carburetted water gas.

Several forms of apparatus have been in use for reclaiming these condensable hydrocarbons, and they have usually given satisfaction and proven a wise investment. The apparatus usually operates by permitting the gas to pass through a series of diaphragms over which the light oils direct from the hydraulic main are permitted to flow.

A few years ago, while engaged in some expert work investigating the merits of the proposed new gas process, the writer, after a varied series of experiments, was forced to the conclusion that in operating coal gas benches in which blue water gas was a factor, a slight suction was necessary to prevent the light gas escaping through the walls of the retorts into the furnaces, and the furnace gases themselves had a way of getting through into the retort when the suction was ever so light. The decarbonization of the retorts by the water gas will produce this effect, no matter how much care is exercised.

With iron retorts, which were used for a while in these experiments, this action was avoided and results were obtained that could be relied upon, and it was found that preheated water gases in small quantities hastened the carbonization of the coal. That much of the condensable hydrocarbons of the tar were fixed in the gas, and that there was an immaterial increase in the yield due to this action, but, at the same time, the specific gravity of the gas was greatly decreased owing to the decomposition of the heavy hydrocarbons, thus increasing the volume slightly,

I give below some figures on the assay of coal tar obtained from straight coal gas and afterwards when water gas is present:

	Straight Coal Tar.	Mixed Tar.
Pitch	72.31	79.16
Light oils	2.41	1.00
Anthracene oils	1.53	32
Creosote oils	1.95	12
Ammonia	21.80	19.40

The specific gravity of the gas fell from .801 of the pure coal gas to .690 of the mixed gas.

It is the opinion of the writer that when Professor Lewes has had the fickleness of water gas in coal gas retorts sufficiently impressed upon him, he will gladly forego even the benefits derived from the light oils in the tar, and be contented with mixing his gas in the purifiers, the same as common, ordinary gas men.

Very truly yours, F. C. SLADE.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

"L. F. R.," writing from Appleton, Wis., under date of the 14th inst., says: "It may be taken for granted that the United Gas and Electric Corporation, of which Mr. Thomas A. Rockwell, President of the Fox River Valley Gas and Electric Company, is Chairman, has purchased the gas and electric interests at Ishpeming, Mich. This purchase includes the electric light and gas plants of Negaunee and Ishpeming, and an electric railway giving service to the places named."

WE are informed that a charter has been issued to the Hocking Valley Consolidated Gas Company, of Parkersburg, West Va., to construct and operate a gas plant in the named city. The incorporators are Messrs. Daniel A. Cameron, of Pittsburg, Pa.; R. D. Crawford, Marietta, O.; V. B. Archer, J. T. Harris and J. D. Wetherell, Parkersburg.

851 EQUITABLE BUILDING, BALTIMORE, MD., August 17, 1903.

To the Editors AMERICAN GAS LIGHT JOURNAL: In your issue of August 10th you report that Colonel E. G. Pratt, of the Milwaukee Gas Light Company, has made improvements in the methods of collecting gas accounts there by dividing the city into three districts, for the purpose of reading the meters, under which arrangement the gas bills will be rendered on the 10th, 20th and 30th of each month, and not on the last of the month as formerly, which required a large number of the office force, in addition to a temporary supply of extra men, to read the meters. The idea is a good one; but why not carry it still further? and, instead of having only 3 pay days in a month, subdivide the work of indexing still more, and thus read a given portion of the meters daily and render the gas bills accordingly. By so doing a company could execute one 25th of its entire monthly business each working day in the month, excluding Sundays and holidays. Soon after the consolidation of the gas companies in Baltimore City, in 1880, it fell to my lot to reconstruct the methods then in vogue for doing business. Among other things, I found that the Company was taking indexes and rendering bills under a plan similar to that which you have described. As a consequence the office was generally crowded with people three times in a month, or on each pay day, and the entire clerical force was on the rush to accommodate the customers, which not only resulted in much confusion in the office but led to many errors. In order to meet these troubles and overcome them I formulated and put into practice a plan by which the city was divided into 25 sections, marked, A, B, C, D, etc., and caused the indexes to be taken and the bills delivered on fixed daily dates in the month. Under this arrangement I had 25 pay days to each month. In other words, I executed one 25th of my business daily. The advantage of this system was that I not only prevented office crowding but uniformly distributed my working force and so avoided all confusion and greatly reduced the errors which enabled me to make a daily auditing and balancing of ac counts. I continued this system during my terms as Secretary of the Consolidated Gas Company, of Baltimore, and found that it gave entire satisfaction, greatly reducing the number of meter readers and the amount of the payrolls for this branch of the work. In making the changes which I have described, I at first divided the city into 12 districts, and subsequently into 25 parts, as stated. It occurred to me that perhaps Col. Pratt has some such plan in view for the future. In any event I have written the above for what it is worth, and will be glad to have you make whatever use of it you choose, looking to the improvement of the methods of conducting the gas business.

Yours, very truly, N. T. MEGINNIS.

A PETITION for a hearing in equity was recently filed with Associate Justice Wm. J. Whitehouse, of the Superior Court, Augusta, Me., and the date for such hearing was agreed upon. The plaintiff in the case is the Oakland Woollen Company, and the defendant is the Union Gas and Electric Company, of Waterville, Me. The plaintiff seeks to to have an injunction enjoining the defendant from keeping the sluiceways in the dam at Oakland open. Plaintiff sets forth that the keeping of this sluice open interferes with its right, inasmuch as it reduces the head of the water at the dam, consequently reducing the amount of power available for its plant. Mr. Harvey D. Eaton, of Waterville, represents the plaintiff, and Mr. Chas. F. Johnson, of Waterville, appears for the defendant.

THE extensions to the plant of the Lexington (Mass.) Gas and Electric Light Company are well underway. The main part of the expenditure goes towards renewing the electric lighting end of the works.

A CORRESPONDENT in Asbury Park, N. J., writing under date of the 15th inst., says: "Press despatches of recent date, respecting the probable laying on of gas in Ocean Grove shortly, are undoubtedly true. The fact is that gas will be supplied there late in the fall, and that during the winter Welsbach lamps will be used for the illumination of the streets. The latter, of course, will only be employed as 'aides' to the incandescent electric lamps heretofore maintained; for the bishops and others interested in the property are firm believers in the brands of electric illumination that they supply from the worst ramshackle electric lighting station in the State of New Jersey."

THE revised selling rates by the Pottsville (Pa.) Gas Company will go into effect October 1st. Under the revision gas for illuminating use is to be sold at $1.50 per 1,000; that for fuel use to go at $1.25 per 1,000. If accounts are not settled within 15 days from presentation of bills, an amount equal to 10 per cent of the face value will be added.

THE following is from a recent issue of the Stroudsburg (Pa.) *Times:* "There has been a change in the management of the Monroe County Gas Company the past few days, C. C. Hartpence, of New York, having purchased the majority of the stock and bonds of the Company, including the interests of President E. R. Case. 'I've not secured the controlling interest in the Company,' said Mr. Hartpence, 'on a speculation, but because I believe there is a chance to build up the business here by giving good service and the best we possibly can for the money. I intend to give the patrons the best I know how, and expect fair treatment in return.'"

MR. GEOEGE W. BROOKE, of Atlanta, Ga., has been selected as umpire to act in the franchise arbitration between the Atlanta Gas Light Company and the State.

THE Louisville (Ky.) Gas Company has arranged for the construction of a storage holder up to the retaining of 1,000,000 cubic feet. It is to be located at the corner of Seventh and Dumensil streets.

MR. GEORGE J. FULLERTON has resigned the Superintendency of the Leechburg Natural Gas Company. He was formerly with the Hyde Park Gas Company, of Chicago.

THE Nassau County Gas Company, the main place of business of which is in Hempstead, L. I., has been granted the privilege of laying and maintaining mains through the Merrick road to the incorporated village of Freeport for a period of 99 years.

ACCORDING to the Springfield (Mass.) *Republican*, Manager William H. Snow, of the Holyoke (Mass.) municipal gas and electric light department, has issued a financial statement embodying the most important facts connected with the business from December 15, 1902, to July 1, 1903. The context of the financial showing is as follows: Receipts, $123,201; running expenses, $86,753; excess of receipts over running expenses, $36,448; bond payments accrued, $14,000; interest payments on bonds, $13,729; total, $27,729; excess of receipts over expenditures, $8,718; 5 per cent. depreciation required by law, $23,007; deficit, $14,288. There have been extensions made to the plants as follows: Gas plant, $10,121; electric plant, $4,065; total, $14,187. Regarding the figures, Manager Snow says: "The statement of the gas and electric department for the first 6 months, ending July 1, shows that at present there can be no reduction in the price of gas or electricity. While there is an excess of receipts over actual cash payments of $8,718, yet the law requires that at least 5 per cent. for depreciation be charged annually on the total cost of the plants, which includes litigation, land, machinery and bonus for the water power, and this is in addition to the amounts paid annually for the extinguishing of the bonds issued when the plants were purchased. In other words, we pay $24,000 a year for the reduction of our bonded indebtedness; so that, at the end of 30 years, this will be paid in full; but in addition to this, we are compelled to charge off the sum of $46,000 this year for the depreciation of the plants. Nor is any allowance made for the extensions which have been put in. While this depreciation charge is purely a matter of bookkeeping, it will necessarily cause the plants to make a poor showing; but this depreciation charge will decrease each year, and also the interest payments, as the bonds are paid. So that, while for the first two years probably, the plants will not make a favorable showing, at the end of that time, the balance, including the depreciation charge, should commence to be on the right side. It will be seen, however, that the most careful financial management is necessary in order that these plants will not be a great burden to the taxpayer."

A RECENT issue of the Baltimore *American* has this to say: "Mr. R. K. Wood, Manager of the Maryland Steel Company, at Sparrows' Point, says that the work upon the project of piping gas from the coke ovens at the Point to the city for the Consolidated Gas Company will begin very soon. He said that it would take at least 6 months for the work to be completed. The line will cost in the neighborhood of $500,000. The contract, which has been signed by both of the large corporations interested, calls for a minimum supply of 4,000,000 cubic feet of gas daily. Negotiations are to be entered into with a prominent engineer of the city for the purpose of surveying several routes between Sparrows' Point and the Canton works of the Company. The gas to be piped to Baltimore will have to be purified and enriched at the Gas Company's works."

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHAS. E. SANDERSON,
MANAGER.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
No. 42 Pine Street, New York.
Telephone, 2996 John.

TERMS:

SUBSCRIPTION—Three Dollars per annum, in advance
Single copies, 10 Cents.

The JOURNAL is the official organ of the
NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.
AMERICAN GAS LIGHT ASSOCIATION.
WESTERN GAS ASSOCIATION.
OHIO GAS LIGHT ASSOCIATION.

NOTIFICATION RESPECTING ADVERTISING.

Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday

AGENTS:

New York—American News Co., 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, AUGUST 24, 1903

The Market for Gas Securities.

The existing market conditions seem to point the way to the belief that a truce between the shorts and the longs has been declared. The basis of the truce, however, cannot be claimed a stable one, since it is clearly of the order that fear rules both parties thereto or thereof. Perhaps there is more confidence on the long than the short side, and it is undeniable that in the last fortnight many thousands of shares of stocks of all sorts have been taken outright from the market and put away in the hoardings of those who never purchased stocks before. This, in the main, is a healthy sign, and speaks well for the gain in a general way of financial knowledge on the part of the people who have made it easy heretofore for savings bank kings to live in comfort and to pose as the friends of the poor.

Quotations for gas stocks this week are not notably wide of those printed a week ago, save in the instance of Mutual, which the peggers have put at 250 bid, offered at 285. A well-known financier of this city stands ready to buy 1,000 shares of Mutual at 290, but he will never get it. The reported quotation is worthless. Another jingo quotation is that for Brooklyn Union. Peoples, of Chicago, stands up well. To sum up the situation all gas shares are cheap at the prices quoted on the high side. Well informed people advise the purchase of Denver (Col.) gas at anything under 30.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

AUGUST 24.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	177⅛	178⅛
Central Union, Bonds, 5's.	3,000,000	1,000	105	108
Equitable Bonds, 6's	1,000,000	1,000	105	
" 1st Con. 5's	2,300,000	1,000	118	120
Metropolitan	658,000		108	112
Mutual	3,500,000	100	250	285
Municipal Bonds	750,000	.		
New Amsterdam Gas Co.				
Bonds, 5's	11,000,000	1,000	102	106
Northern Union, Bonds, 5's.	1,250,000	1,000	105	106⅛
New York and East River				
Bonds 1st 5's	3,500,000	1,000	102	06
" 1st Con. 5's	1,500,000		109	111
Standard	5,000,000	100	135	140
Preferred	5,000,000	100	155	170
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	117
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	180	200
" " Bonds (5's)	15,000,000	1,000	119	119⅛
Bay State	50,000,000	50	⅛	3/16
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	28	30
" 1st Mtg. 5's	500,000	1,000	93	96
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47⅛	50
Buffalo City Gas Co.	5,500,000	100	4	5
" " Bonds, 5's	5,250,000	1,000	73	76
Capital, Sacramento	500,000	50	.	35
Bonds (6's)	150,000	1,000	..	..
Central, San Francisco	1,900,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104⅛
Cincinnati Gas & Elec. Co.	29,500,000	100	96	95⅞
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	101	101⅛
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¾	89¼
Preferred	3,026,500	100	10.⅛	109
Consumers, Jersey City Bonds	600,000	1,000	100	102
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	65	66
Mortgage, 6's	3,600,000	..	..	11[illegible]
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	85	87
Consolidated G. & E. Co.'s.				
Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,825,500	50	87	95
" Prior Lien 5's	5,603,000	1,000	99⅛	100
Detroit Gas Co., 5's	1,1,000	1,000	77	79
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	..	65
" Bonds, 6's	2,650,000	..	104¾	106
Jackson Gas Co	250,000	50	73	75
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	79	90
Preferred	2,500,000	100	85	..
Bonds	10,000,000	1,000	109½	110
Lafayette Gas Co., Ind.	1,000,000	100	.	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	130	140
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	107½	108½
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	184¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co	6,000,000	..	56	58
Bonds, 6's	4,600,000		105	105¾
New Haven	1,000,000	25	300	325
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	.
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	93	94
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	..
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87⅛	90
San Francisco, Cal	0,000,000	100	51½	52
St. Joseph Gas Co.				
" 1st Mtg. 5's	751,000	1,000	95	96⅛
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112¾	115
General Mortgage, 5's	2,465,000	1,000	92	98
Syracuse, N. Y.	1,975,000	100	46	48
Bonds	2,047.000	1,000	98⅛	99½
Washington, D. C	2,600,000	20	290	295
First mortgage 6's	600,000	..	..	..
Western, Milwaukee.				
Bonds, 5's	4,000,000	.	109¼	110
Wilmington, Del.	600,000	50	232	

Advertisers' Index.

GAS ENGINEERS. Page

A. E. Boardman, New York City ... 312
Baxter & Young, Detroit, Mich ... 312
B. E. Chollar, St. Louis, Mo ... 302
David Leavitt Hough, New York City ... 312
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 304
Frank D. Moses, Trenton, N. J ... 298
Fred. Bredel Co., Milwaukee, Wis ... 300
Geo. R. Rowland, New York City ... 302
Humphreys & Glasgow, New York City ... 313
Kerr Murray Mfg. Co., Fort Wayne, Ind. ... 312
The Gas Machinery Co., Cleveland, O ... 299
The Jeffrey Manufacturing Co., Columbus, O ... 296
The Western Gas Construction Co., Fort Wayne, Ind. ... 320
United Gas Improvement Co., Philadelphia, Pa ... 307
Wm. Henry White, New York City ... 315

GAS WORKS APPARATUS AND CONSTRUCTION.

A. E. Boardman, New York City ... 312
Bartlett, Hayward & Co., Baltimore, Md ... 313
Baxter & Young, Detroit, Mich ... 312
Christopher Cunningham, Brooklyn, N.Y ... 309
Connelly Iron Sponge and Governor Co., New York City 308
Continental Iron Works, Brooklyn, N. Y ... 314
Cruse-Kemper Co., Philadelphia, Pa ... 299
Davis and Farnum Mfg. Co., Waltham, Mass ... 312
Delly & Fowler, Philadelphia, Pa ... 316
Economical Gas Apparatus Construct'n Co., Toronto, Ont 304
Frank D. Moses, Trenton, N. J ... 298
Fred. Bredel Co., Milwaukee, Wis ... 300
G. Shepard Page's Sons, New York City ... 312
Humphreys & Glasgow, New York City ... 313
Isbell-Porter Company, New York City ... 314
Kerr Murray Mfg. Co., Fort Wayne, Ind ... 312
Lloyd Construction Co., Detroit, Mich ... 302
Logan Iron Works, Brooklyn, N. Y ... 316
Quintard Iron Works, New York City ... 313
R. D. Wood & Co., Philadelphia, Pa ... 314
Riter-Conley Mfg. Co., Pittsburg, Pa ... 315
Stacey Mfg. Co., Cincinnati, O ... 315
The Connersville Blower Company, Connersville, Ind ... 317
The Gas Machinery Co., Cleveland, O ... 297
The Jeffrey Manufacturing Co., Columbus, O ... 296
The Western Gas Construction Co., Fort Wayne, Ind ... 320
United Gas Improvement Co., Philadelphia, Pa ... 307

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md ... 313
B. E. Chollar, St. Louis, Mo ... 302
Economical Gas Apparatus Construct'n Co, Toronto, Ont. 314
Humphreys & Glasgow, New York City ... 318
The Gas Machinery Co., Cleveland, O ... 297
The Western Gas Construction Co., Fort Wayne, Ind ... 320
United Gas Improvement Co., Philadelphia, Pa ... 307

SCRUBBERS AND CONDENSERS.

Continental Iron Works, Brooklyn, N.Y ... 314
Kerr Murray Mfg. Co., Fort Wayne, Ind ... 312
Logan Iron Works, Brooklyn, N. Y ... 316
R. D. Wood & Co., Philadelphia, Pa ... 314
Riter-Conley Mfg. Co., Pittsburg, Pa ... 315
Stacey Mfg. Co., Cincinnati, O ... 315
The Gas Machinery Co., Cleveland, O ... 297
The Western Gas Construction Co., Fort Wayne, Ind ... 320

PRODUCER POWER PLANTS.

R. D. Wood & Co., Philadelphia, Pa ... 314

TAR AND CARBONIC ACID EXTRACTOR.

Stacey Mfg. Co., Cincinnati, O ... 315
The Gas Machinery Co., Cleveland, O ... 297
The Western Gas Construction Co, Fort Wayne, Ind ... 320

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich..... 296
The Gas Machinery Co., Cleveland, O..... 297
The Western Gas Construction Co., Fort Wayne, Ind... 320

GAS METERS.

American Meter Co., New York and Philadelphia..... 319
Detroit Meter Company, Detroit, Mich..... 319
D. McDonald & Co., Albany, N.Y..... 317
Helme & McIlhenny, Philadelphia, Pa..... 319
John J. Griffin & Co., Philadelphia, Pa..... 280
Keystone Meter Co., Royersford, Pa..... 318
Maryland Meter and Mfg. Co., Baltimore, Md..... 318
Metric Metal Co., Erie, Pa..... 319
Nathaniel Tufts Meter Co., Boston, Mass..... 318

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia..... 319
D. McDonald & Co., Albany, N. Y..... 317
Helme & McIlhenny, Philadelphia, Pa..... 319
John J. Griffin & Co., Philadelphia, Pa..... 280
Keystone Meter Co., Royersford, Pa..... 318
Nathaniel Tufts Meter Co., Boston, Mass..... 318

PREPAYMENT METER ATTACHMENTS.

Reeves Mfg. Co., New Haven, Conn..... 300

GAS AND WATER PIPES.

Charles Millar & Son Co., Utica, N. Y..... 304
Christopher Cunningham, Brooklyn, N.Y..... 309
Davis & Farnum Mfg. Co., Waltham, Mass..... 312
Donaldson Iron Co., Emaus, Pa..... 304
M. J. Drummond & Co., New York City..... 304
R. D. Wood & Co., Philadelphia, Pa..... 314
Warren Foundry and Machine Co., New York City..... 304

NON-RUSTING PIPE LUBRICANT.

Alan H. Tripp, Chicago, Ills..... 296

GAS COALS.

Berwind-White Coal Mining Co., New York and Phila . 310
Perkins & Co., New York City..... 310
Westmoreland Coal Co., Philadelphia, Pa..... 311

SPECIALTIES FOR OIL AND PIPE LINES.

S. R. Dresser, Bradford, Pa..... 301

GAS MAIN STOPPERS.

Safety Gas Main Stopper Co., N.Y. City..... 304

GAS TAPPING MACHINES.

George Light, Dayton, O.. 304
H. Mueller Manufacturing Company, Decatur, Ills..... 301

CANNEL COALS.

Perkins & Co., New York City..... 310

STOKING MACHINERY.

G. A. Bronder, New York City..... 309

AUTOMATIC WEIGHING MACHINERY.

Richardson Scale Co., New York City..... 309

CONVEYORS.

C. W. Hunt Company, New York City..... 301
G. A. Bronder, New York City..... 309
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 312
The Gas Machinery Co., Cleveland, O..... 297
The Jeffrey Manufacturing Co., Columbus, O..... 296
The Link-Belt Machinery Co., Chicago, Ills..... 311
The Western Gas Construction Co., Fort Wayne, Ind... 320

CHARGING BARROWS & COAL WAGONS.

Kerr Murray Mfg. Co., Fort Wayne, Ind..... 312
Stacey Mfg. Co., Cincinnati, O..... 315

GAS ENRICHERS.

Standard Oil Co., New York City..... 311
The Sun Oil Co., Pittsburg, Pa..... 311

COKE CRUSHERS.

C. M. Keller, Columbus, Ind..... 311
The Jeffrey Manufacturing Co., Columbus, O..... 296

STEAM BLOWER FOR BURNING BREEZE.

The Connersville Blower Company, Connersville, Ind... 317

ECONOMIZERS.

Green Fuel Economizer Co., Matteawan, N.Y..... 302

GAS GAUGES.

The Bristol Co., Waterbury, Conn..... 296

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City 308
Isbell-Porter Co., New York City..... 314
R. D. Wood & Co., Philadelphia, Pa..... 314

CEMENTS.

C. L. Gerould, Galesburg, Ills..... 308

RETORTS AND FIREBRICKS.

Adam Weber Sons, New York City..... 308
Baltimore Retort and Firebrick Co., Baltimore, Md..... 308
Brooklyn Firebrick Works, Brooklyn, N. Y..... 308
Henry Maurer & Son, New York City..... 308
James Gardner, Jr., Co., Pittsburg, Pa..... 308
J. H. Gautier & Co., Jersey City, N. J..... 308
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 308
Missouri Firebrick Co., St. Louis, Mo..... 308
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 297
The Kreischer Brick Mfg. Co., New York City..... 308

(*Continued on page 296.*)

SITUATION WANTED
AS MANAGER,

By a young man thoroughly familiar with every department of the business. Successful in economical operation and in developing new business. Can guarantee results. Energetic and capable. Address, "RESULTS,"
1471-2 Care this Journal.

WANTED,
Position as Manager or Superintendent

Of a gas works in a town of 20,000 to 30,000, or as Assistant Superintendent in a large plant. Have had 8 years' experience as superintendent, and am thoroughly familiar with all details of the business.
1471-2 Address, "G. H. S.," care this Journal.

Position Wanted.

Young man, of 12 years' experience in the successful management of gas plants, desires position as manager or superintendent of medium size plant, or foreman of manufacturing department of large size works.
1470-3 Address, "PENN," care this Journal.

Situation Wanted
As Manager or Superintendent of Small Coal or Water Gas Plant,

By a man 45 years old. Successful and economical in operation and up to developing new business. Thoroughly practical and experienced in all branches. Progressive. First-class references given. Address, "S.,"
1471-tf Care this Journal.

POSITION WANTED
AS MANAGER or SUPERINTENDENT,

By a successful hustler for new business. Experienced in selling gas stoves; laying high and low pressure mains; understands the manufacture of coal and water gas in detail; also, reconstruction of benches and water gas apparatus. Superintendent of gas company for a number of years. Will find me up-to-date and energetic young man. Can furnish best of references. Address,
1470-5 "PUSHER," care this Journal.

Position Wanted
BY A PRACTICAL GAS MANAGER.

Fifteen years' experience in construction, manufacture and distribution of both coal and water gas in various types. Also able to inventory and place the business and office records upon an improved and proper basis of accounting; being practical and successful in all details of the business. Address, "PROGRESS,"
1469-tf Care this Journal.

WANTED,
Two Capable Erecting Foremen,

By THE GAS MACHINERY COMPANY, CLEVELAND, O.

Only experienced and reliable men need apply.
1471-3

WANTED,
A Young Man to Take Charge of New Business Department,

And make himself generally useful, with a coal gas plant in the Middle-West, sending out about 40,000,000 cubic feet. State salary expected. References required.
1471-3 Address, "MIDDLE-WEST," care this Journal.

METER FOR SALE.
One 300-Light Maryland Meter.

The Maryland Meter Company will vouch for good condition of this meter. For particulars, address,
1465-tf OTTAWA GAS LIGHT & COKE CO., Ottawa, Ills.

FOR SALE.

Two Rectangular, Cast Iron, Water Tube Condensers, 5 feet 6 inches wide, by 15 feet 10 inches high, by 36 feet 10 inches long, with 20-inch valves and connections.
One Rectangular, Cast Iron Scrubber, 5 feet 6 inches wide, by 12 feet high, by 36 feet 10 inches long, with 20-inch valves and connections.
Sixteen Sections of Cast Iron Hydraulic Main, 8 feet 4 inches long by 24 inches, for benches of 6's; dip and bridge pipes; 7-inch ascension pipes; supports for hydraulic main; 4 take-off ends, with 12 inch outlets; adjustable valves, with Hutchison tar draw-off pots.
Seventy-eight Self-Sealing Mouthpieces, each 18 by 24.
One Fuller Vertical Engine, 8 by 12, with exhauster governor.
One Fuller Vertical Engine, 9 by 14, with exhauster governor.
One McKenzie Exhauster, 16-inch valves and connections.
One Wilbraham Exhauster, 16-inch valves and connections
One 12-Inch By-Pass, with Smith & Sayre compensator; 6-inch connections.
One P. & A. Tar Extractor, 1,000,000 cubic feet capacity; 16-inch connections
One Wrought Iron Tower Scrubber, 6 feet diameter by 29 feet 6 inches high; 16-inch valves and connections.
Two Wrought Iron Scrubbers, 7 feet diameter by 16 feet high, with 16-inch valves and connections.
Three Wrought Iron Condensers, each 6 feet diameter by 16 feet high, with 16-inch valves and connections.
Two Standard Washer-Scrubbers, No. 13, with 20-inch valves and connections.

All the above apparatus, if examined at once, can be seen connected and in operation. It will be removed to give room to larger apparatus. Any further information can be obtained from the PROVIDENCE GAS COMPANY,
1462-tf Providence, R. I.

FOR SALE,
Two Settings of Single Superheater Lowe Water Gas Apparatus.

Address,

WILLIAMSPORT GAS COMPANY,
1463-tf WILLIAMSPORT, PA.

FOR SALE.
ONE NO. IV. ROOT ROTARY EXHAUSTER.

Reason for selling: Too small. Can be seen in operation at these works.

DAYTON GAS LIGHT AND COKE COMPANY,
1470-tf DAYTON, O.

FOR SALE.
One High Pressure Roots' Exhauster and Engine,

On one bed. This machine is practically new, and has been delivering 100,000 per day, through 8 miles of 4-inch pipe line. Engine is direct connected to exhauster, and with them is included one cooling tank and all 8-inch connections.
1457-tf Address, "F. R. V.," care this Journal.

Gas Analyses of All Sorts and Conditions,
—OR—
Analyses of Solid and Liquid Materials as Well,

That are needed by Gas Companies at any time in the conduct of their business, may be obtained from

DR. W. H. BIRCHMORE,
1421-tf 341 ADELPHI ST., BROOKLYN, N Y

(*Concluded from page 295.*)

INCLINED RETORTS.

Adam Weber Sons (Graham, Morton [England] System) 308
Connelly Iron Sponge & Gov. Co. (Drake's [Eng.] System) 303
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 297

VERTICAL S'S.

Adam Weber Sons (Oscar B. Weber's Construction)..... 298
Connelly Iron Sponge & Gov. Co. (Drake's [Eng.] System) 308
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 297

REGENERATIVE FURNACES.

Adam Weber Sons, New York City..... 308
Bartlett, Hayward & Co., Baltimore, Md..... 313
Fred. Bredel Co., Milwaukee, Wis..... 300
J. H. Gautier & Co., Jersey City, N.J..... 308
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 308
Missouri Firebrick Co., St. Louis, Mo..... 308
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 297

SELF-SEALING MOUTHPIECE DOORS.

Continental Iron Works, Brooklyn, N.Y. 314
Isbell-Porter Co., New York City..... 314
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 312
Logan Iron Works, Brooklyn, N.Y..... 316
R. D. Wood & Co., Philadelphia, Pa..... 314
Stacey Mfg. Co., Cincinnati, O..... 315
The Gas Machinery Co., Cleveland, O..... 297
The Western Gas Construction Co., Fort Wayne, Ind... 320

CHIMNEY CONSTRUCTION.

Adam Weber Sons, New York City..... 308

INCANDESCENT GAS LAMPS.

Ball Check Light Co., New York City..... 298
D. M. Steward Mfg. Co., Chattanooga, Tenn..... 300
Welsbach Company, Gloucester, N. J..... 306

BURNERS.

C. A. Gefrorer, Philadelphia, Pa..... 300
D. M. Steward Mfg. Co., Chattanooga, Tenn..... 300
Wm. M. Crane Co., New York City..... 301

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn..... 300

STREET LAMPS.

Thos. T. W. Miner, New York City..... 301
Welsbach Street Lighting Co., New York and Phila.... 299

PURIFIERS.

Connelly Iron Sponge and Governor Co., New York City. 303
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 312
R. D. Wood & Co., Philadelphia, Pa..... 314
Stacey Mfg. Co., Cincinnati, O..... 315
The Western Gas Construction Co., Fort Wayne, Ind... 320

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 303

VALVES.

Continental Iron Works, Brooklyn, N. Y..... 314
Isbell-Porter Co., New York City..... 314
Kerr Murray Mfg. Co., Fort Wayne, Ind 312
Ludlow Valve Manufacturing Co., Troy, N.Y..... 301
R. D. Wood & Co., Philadelphia, Pa..... 314
Stacey Mfg. Co., Cincinnati, O..... 315
The P. H. & F. M. Roots Co., Connersville, Ind..... 263
The Western Gas Construction Co., Fort Wayne, Ind... 320

EXHAUSTERS.

Connelly Iron Sponge and Governor Co., New York City 303
Isbell-Porter Company, New York City..... 314
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 312
The Connersville Blower Company, Connersville, Ind... 313
The P. H. & F. M. Roots Co., Connersville, Ind.... 263

ELECTRICAL APPARATUS.

Wm. Henry White, New York City..... 315

PURIFIER SCREENS.

John Cabot, New York City..... 300

GAS STOVES.

American Meter Co., New York and Philadelphia..... 305
Keystone Meter Co., Royersford, Pa..... 318
Maryland Meter and Manufacturing Co., Baltimore, Md. 318
Nathaniel Tufts Meter Co., Boston Mass..... 318

HOT WATER HEATERS.

The Humphrey Mfg. and Plating Co., Kalamazoo, Mich. 304

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N.Y..... 302

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md..... 313
Continental Iron Works, Brooklyn, N.Y..... 314
Cruse-Kemper Co., Philadelphia, Pa. 299
Davis & Farnum Mfg. Co., Waltham, Mass..... 312
Deily & Fowler, Philadelphia, Pa..... 316
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 312
Logan Iron Works, Brooklyn, N.Y..... 316
R. D. Wood & Co., Philadelphia, Pa..... 314
Riter-Conley Mfg. Co., Pittsburg, Pa..... 315
Stacey Mfg. Co., Cincinnati, O..... 315

STORAGE TANKS.

Christopher Cunningham, Brooklyn, N.Y..... 309
Stacey Mfg. Co., Cincinnati, O..... 315

AUTOMATIC SCALES.

Richardson Scale Co., New York City..... 300

INVESTORS.

W. R. Faben Construction Company, Toledo, O..... 300

PATENTS, TRADE-MARKS, COPYRIGHTS.

Royal E. Burnham, Washington, D. C..... 300

Utilize Your Gas Liquor.

NO EXTRA LABOR OR OPERATING EXPENSES.

IMPROVED AMMONIA CONCENTRATOR.

About 100 in use. Write to

STROH & OSIUS, Patentees, or

MICHIGAN AMMONIA WORKS, - Detroit, Mich.

Bristol's Recording

PRESSURE GAUGE.

For continuous records of **Street Gas Pressure.** Simple in construction, accurate in operation and low in price.

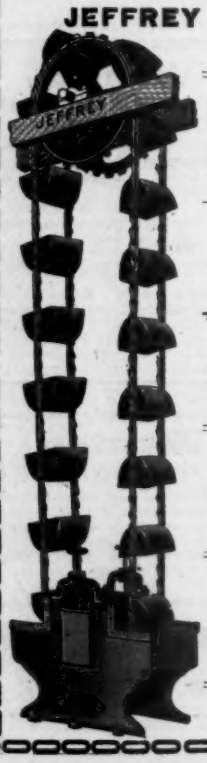
Fully Guaranteed. Send for Circulars.

THE BRISTOL CO.,

Waterbury, Conn.

Silver Medal, Paris Exposition.

JEFFREY ELEVATORS FOR ALL KINDS OF WORK.



COAL HANDLING MACHINERY.

COKE CRUSHERS.

SHAKING SCREENS.

POWER TRANSMISSION MACHINERY.

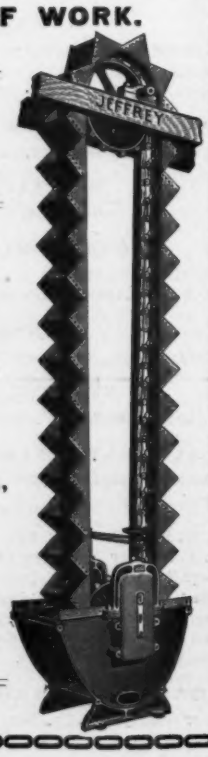
ASHES HANDLING MACHINERY.

SEND FOR CATALOGUE.

THE JEFFREY MFG. CO.,

COLUMBUS, O., U. S. A.

NEW YORK, CHICAGO, DENVER, BUFFALO, PHILADELPHIA.



For Gas Pipe Threads Use

TRIPP'S celebrated Non-Rusting PIPE LUBRICANT. Sold on an absolute 30-day guarantee to be superior and cheaper to any Pipe Cement or Red and White Lead. The only material that does not harden up in can when mixed. 50-lb. pail shipped on 30-day trial F.O.B. Chicago, $4.75. Will do the work of 150 lbs. of Red Lead.

REFERENCES.—The Peoples Gas Light and Coke Co., Chicago. . . The Jacksonville Gas Co., Jacksonville, Ills. . . Canton Gas Co., Canton, Ills. . . Galesburg Gas Co., Galesburg, Ills., etc., etc. . . The Bloomington Gas Co. writes: June 26, 1903—Alan H. Tripp, Chicago, Dear Sir: In placing our second order for your Non-Rusting Pipe Lubricant, we wish to say that the sample pail you sent us proved to be satisfactory in every way, which accounts for this second order. Yours truly, Union Gas and Electric Co., J. A. Wilcox, President, Bloomington, Ills.

ALAN H. TRIPP,
The Gasfitters' Friend.

☞ Order a sample 50-lb. pail to-day.

ALAN H. TRIPP,

Sole Inventor and Manufacturer,

177 East 40th Street, Chicago, Ills.

TELEPHONE, DREXEL, 3043.

PARKER-RUSSELL MINING AND MFG. CO.,

PROPRIETORS OF THE

OAK HILL GAS RETORT AND FIREBRICK WORKS.

St. Louis Office: 417 Pine Street. **New York Office:** Aldrich Court, 45 Broadway.

WE MAKE A SPECIALTY OF WATER GAS LININGS AND CHECKER BRICK.

Half and Full Depth Benches of Our Own Design, Containing 6, 8 or 9 Retorts.

SLOPERS—We have perfected plans of INCLINED RETORT BENCHES, designed to meet conditions prevailing in America, and constructed entirely of American materials.

We Build Benches Complete, Ready for Gas Making. Also

RETORT HOUSES,

COAL and COKE CONVEYING MACHINERY.

Plans, Specifications and Estimates Cheerfully Furnished.

CORRESPONDENCE SOLICITED.

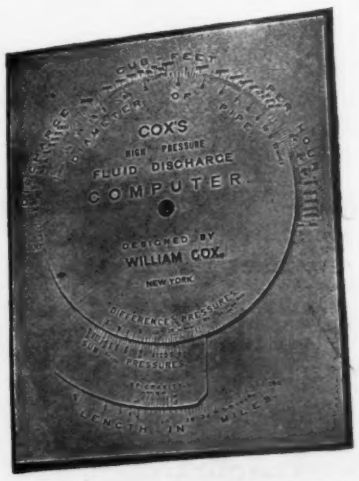
P. PLANTINGA, President. W. E. STEINWEDELL, Secretary.

THE GAS MACHINERY CO.,

OFFICES: 720-722 CITIZENS BUILDING,

CLEVELAND, OHIO.

Coal and Water Gas Apparatus, Bye-Product Machinery, Structural Work and Connections.



COX'S HIGH-PRESSURE FLUID DISCHARGE COMPUTER.

This Computer solves the following formula, which is applicable to Gas, Air and other elastic fluids, flowing through long pipes with high initial pressures:

$$\text{Discharge in cubic feet per hour at atmospheric pressure} = 33.3\sqrt{\frac{d^5 \times (p_1^2 - p_2^2)}{L \times w}}$$

Where d = diameter of pipe in inches,
p_1 = absolute initial pressure in pounds per square inch,
p_2 = absolute terminal pressure in pounds per square inch,
L = length of pipe in miles,
w = specific gravity of the fluid when air = 1.

To Find the Discharge from a Pipe and the Required Size of Pipe.

(1.) Set the specific gravity of the fluid opposite the length of pipe;
(2.) Bring the DIFFERENCE of the initial and terminal gauge pressures opposite the SUM of the initial and terminal gauge pressures;
(3.) Opposite any diameter of pipe will now be found the discharge in cubic feet per hour at atmospheric pressure; and
(4.) Opposite any desired discharge will also be found the required diameter of pipe.

Price of the Computers, in Cloth Case, 6½ x 8 inches, $5 Each, Net.

A. M. CALLENDER & CO., 42 PINE ST., N. Y.

PRACTICAL HANDBOOK ON GAS ENGINES, WITH INSTRUCTIONS FOR CARE AND WORKING OF THE SAME,

By G. LIECKFELD, C.E. Translated with Permission of the Author, by GEO. M. RICHMOND, M.E. Price, $1.00.

A. M. CALLENDER & CO., 42 PINE ST., NEW YORK CITY.

The Gas Engineer's Laboratory Handbook,

BY JOHN HORNBY, F.I.C. **Price, $2.50.**

Orders may be sent to

A. M. CALLENDER & CO., 42 Pine St., N. Y.

HUGHES' "GAS WORKS,"

Their Construction and Arrangement, and the Distribution of Coal Gas.

Originally written by SAM'L HUGHES, C.E. Rewritten and much enlarged by WM. RICHARDS, C.E.

Eighth Edition, Revised, with Notices of Recent Improvements. Price, $1.65.

A. M. CALLENDER & CO., 42 PINE ST., N. Y. CITY.

SAMPLE
BALL CHECK
By Mail
(To Dealers)
For a Dime.
They Sell For
A Quarter.

BOOKLET
OF OUR
GAS ARC
LAMPS
for the
Asking.

FRANK D. MOSES,

Long Distance Telephone, 1922, Trenton, N. J.

TRENTON, N. J.,

Long Distance Telephone, 1922 Trenton, N. J.

Constructing Engineer and Contractor.

Estimates Furnished on any kind of Work in Connection with Gas or Water Plants.

SPECIAL ATTENTION GIVEN TO THE REMODELLING AND EXTENDING OF THE PROPERTIES OF WORKS NOT UP-TO-DATE.

CORRESPONDENCE SOLICITED.

SCIENTIFIC BOOKS.

ELECTRIC GAS LIGHTING. By H. S. Norrie. 50 cents.

GAS ANALYST'S MANUAL. By J. Abady. $6.50.

JOX'S GAS FLOW COMPUTER. $2.50.

FIELD'S ANALYSIS, 1902. $5.

HUGHES' GAS WORKS. $1.65.

POOLE ON FUELS. By Herman Poole. $3.

GAS ENGINEER'S POCKET-BOOK. By Henry O'Connor $3.50.

TECHNICAL GAS ANALYSIS. $3.

GAS CONSUMER'S HANDYBOOK, by Wm. Richards. 30 cents.

PRACTICAL TREATISE ON HEAT. By Thomas Box. 2d edition. $5.

PRACTICAL PHOTOMETRY: A Guide to the Study of the Measurement of Light. By W. J. Dibdin. $3.

CHEMICAL TECHNOLOGY: Vol. I., *Fuel and its Applications*, $5. Vol. II., *Lighting*, $4.

IRONWORK: Practical Designing of Structural Ironwork. By H. Adams. $3.50.

HEMPEL'S GAS ANALYSIS, $2.25.

LIQUID FUEL FOR MECHANICAL AND INDUSTRIAL PURPOSES. By E. A. Brayley Hodgetts. $2.50.

COAL: Its History and Use. By Prof. Thorpe. $3.50.

PRACTICAL HANDBOOK ON GAS ENGINES, by G. Lieckfeld. $1.

HEAT A MODE OF MOTION. By John Tyndall. $2.50.

THEORY OF HEAT. By J. Clerk-Maxwell. $1.50.

MANUAL FOR GAS ENGINEERING STUDENTS. By D. Lee. 40 cents.

AMMONIA AND AMMONIUM COMPOUNDS. By Dr. R. Arnold. $2.

A TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS. By D. A. Graham. $3.

A TEXT BOOK OF INORGANIC CHEMISTRY. By Prof. Victor Von Richter. $2.

ILLUMINATING AND HEATING GAS. By W. Burns. $1.50

HANDBOOK FOR MECHANICAL ENGINEERS. By H. Adams. $2.50.

TREATISE ON MASONRY CONSTRUCTION. Baker. $5.

GAS ENGINEER'S LABORATORY HANDBOOK. By Jno. Hornby. $2.50.

GAS LIGHTING AND GAS FITTING. By W. P. Gerhard. 50 cents.

PRACTICAL PLUMBING. By P. J. Davies. $3.

AMERICAN PLUMBING. By Alfred Revill. $2.

CEMENT; A Manual of Lime and Cement, their Treatment and Use in Construction. By A. H. Heath. $2.50.

A COMPARISON BETWEEN THE ENGLISH AND FRENCH METHODS OF ASCERTAINING THE ILLUMINATING POWER OF COAL GAS. $1.60.

ELECTRICITY.

INDUSTRIAL PHOTOMETRY, with Special Application to Electric Lighting. By A. Palaz, Sc.D. $4.

ELEMENTS OF ELECTRIC LIGHTING, Including Electric Generation, Measurement, Storage and Distribution. By Philip Atkinson. $1.50.

ELECTRIC TRANSMISSION OF ENERGY. By G. Kapp. $3.50.

ELECTRICIAN'S POCKETBOOK. By Monroe and Jamieson. $2.50.

DYNAMO BUILDING. By F. W. Walker. 50 cents.

DOMESTIC ELECTRICITY FOR AMATEURS. By E. Hospitalier. $2.50.

PRACTICAL MANAGEMENT OF DYNAMOS AND MOTORS. $1.

PRACTICAL GUIDE TO THE TESTING OF INSULATED WIRES AND CABLES. $1.

ELECTRIC LIGHTING, by Francis B. Crocker. $3.

ELECTRIC LIGHT FITTING. $2.

PRACTICAL ELECTRICITY. $2.50.

ELECTRICITY FOR ENGINEERS. $2.50.

ELECTRICITY, Its Theory, Sources and Applications. By John T. Sprague. $6.

The above will be forwarded upon receipt of price. If sent by mail or express, postage or express charges must be added to above prices. We take especial pains in securing and forwarding any other Works that may be desired, upon receipt of order. All remittances should be made by check, draft, or post office money order. No books sent C.O.D.

A. M. CALLENDER & CO., 42 PINE ST., NEW YORK.

AN underlying principle in business is to show an increase each year---to grow. The astute dealer not only seeks to retain this year's customers, but to attract new trade next year.

The formula is simple-

THIS SHIELD IS THE WELSBACH TRADE MARK.

IT IS A GUARANTEE AND A PROTECTION.

Sell The Welsbach Brands.

The imitation stuff is bad for the customer---which is bad for you.

The genuine Welsbachs---Burners or Mantles---make satisfied customers---keep customers---MAKE NEW ONES.

And your profit isn't merely dollars and cents.

WELSBACH CO.,

Broad and Arch Sts., PHILADELPHIA.

ARTHUR R. CRUSE, President. FRANK FLAVELL, Secretary. AARON E. KEMPER, Treasurer.

Cruse=Kemper Company,

PHILADELPHIA OFFICES: Stephen Girard Building. - - WORKS: Ambler, Pa.

Manufacturers of

Triple, Double and Single=Lift Gasholders,

With or Without Metal Tanks,

Oil and Water Tanks, Purifier Covers, General Plate Metal Work, and Steel Water Towers.

Plans, Specifications and Estimates Promptly Furnished on Request.

PRACTICAL PHOTOMETRY,

A GUIDE TO THE STUDY OF THE MEASUREMENT OF LIGHT.

By WILLIAM JOSEPH DIBDIN.

With Numerous Illustrations. Price; $3.00.

A. M. CALLENDER & CO., 42 Pine Street, New York City.

STEWARD LAVA TIPS. ALL SIZES. ALL KINDS.

Greatest care is used in selection of material and making.

YOU CAN GET ANY QUANTITY PROMPTLY FROM OUR THREE BRANCHES.

THE D. M. STEWARD MFG. CO., ESTABLISHED 1876.

NEW YORK: 8–12 JAY STREET. CHICAGO: 57 WASHINGTON STREET. FACTORY AND GENERAL OFFICE: CHATTANOOGA, TENN. 2

IN THE MARKET.

WE PURCHASE:

Gas properties,
Electric light properties.
Street railway properties.
Also desirable franchises.

W. R. FABEN CONSTRUCTION CO.,

1383-tf 317 St. Claire Street, Toledo, O.

GAS BURNERS,

To burn a given amount at a stated pressure, made to order. Samples furnished. Also, small oil and air valves, slow-feed valves for high pressure, and small brasswork in general.

Drip Pumps, Service Cleaners, Gasfitters' Proving Pumps and Mercury Gauges.

C. GEFRORER & SON,

248 North 8th Street, Philadelphia, Pa.

PATENTS, TRADE-MARKS, COPYRIGHTS.

ROYAL E. BURNHAM,

Solicitor of Patents and Counsellor in Patent Causes.

833 Bond Building, Washington, D. C.

Send for Pamphlet on Patents.

1418-tf

AUTOMATIC SCALES

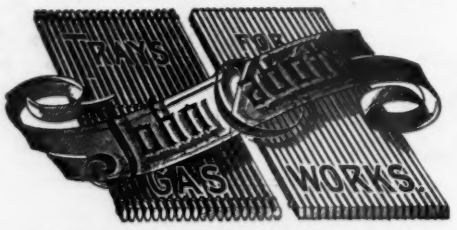
Send for Catalogue.

RICHARDSON SCALE CO., 21 Park Row, NEW YORK CITY.

Church's Patent Trays.

Reversible; Strongest; Most Easily Repaired.

Special Trays for Iron Sponge.



1412-1416 Adams Street, Hoboken, N. J.

We also Supply the Chapest and Strongest

•Reversible Bolted Trays•

IN THE MARKET.

SEND FOR BOOKLET AND CIRCULARS.

ORDER

The **REEVES PREPAYMENT ATTACHMENT** sent to your meter manufacturers; they will attach them. Or order from us and attach them yourselves. The Reeves Prepay has advantages possessed by no other. Ten hours' warning to consumers. Can't be "beaten." Simple. Low price. Now being used by scores of the largest gas companies. Write for sample and descriptive matter.

REEVES MFG. CO., - - - NEW HAVEN, CONN.

FRED. BREDEL, President. WM. O. VILTER, Vice-President. O. W. GREENSLADE, Secretary and Treasurer.

FRED. BREDEL COMPANY,

ENGINEERS AND BUILDERS OF GAS PLANTS.

Inclined Benches, own system, Recuperative Furnaces, Exhausters, Exhauster Governors, Condensers, Washers, Coolers, Wet Purifying Plants, Purifiers, Oxide Elevators, Hydraulic and Dry Coke Conveyors.

Special High Grade Material for Recuperative Furnaces.

Licensees for ARROLL-FOULIS Charging and Discharging Machines and FRONHAUSER Coke Conveyors. OFFICE, 405 KEENE ST., MILWAUKEE, WIS

COAL TAR AND AMMONIA.

THIRD AND ENLARGED EDITION.

BY

GEORGE LUNGE, PH.D.

Price, $15. For Sale by

A. M. CALLENDER & CO., - - 42 Pine Street, New York City.

Bray Burners.

Said the Sun to the Sky:
"For the present, Good-bye!
"I'll see you to-morrow at four"
But when he came back
What had happened? Alack!
There's no use for the sun any more!

Said the Sky to the Sun:
"All your glory is done,
"Hide your face and don't make a row,
"For a chappie named BRAY
"Has turned night into day
"BRAY BURNERS will light the world now!"

Bray Burners are the one burner you can always rely upon as being of uniform quality and greatest candle power.

Beware of Imitations.

William M. Crane Company,

Sole Agents for the United States,

1131-1133 Broadway, New York.

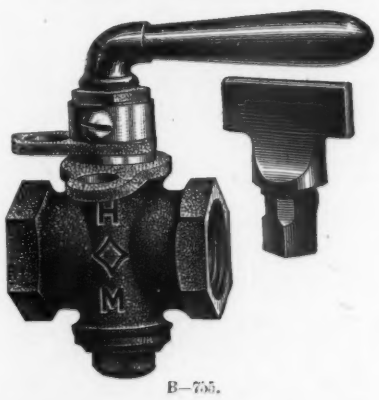
"STEVEDORE" MANILA ROPE FOR HOISTING.

(TRADE MARK.)

Constructing rope from best material only, makes it cost more than common manila rope. We guarantee our "Stevedore" rope to do more work in proportion to its cost than any other rope, whether manila, cotton or other fiber, without any exception whatever, thus making it the cheapest rope that can be used when service is considered. This rope is made from the finest selected manila fiber, laid up with a plumbago and tallow lubricant. IT IS THE ONLY HOISTING ROPE THAT IS NOT MATERIALLY INJURED BY EXPOSURE TO THE WEATHER.

C. W. HUNT COMPANY, { **West New Brighton, N. Y.**
New York City Office, 45 Broadway.

Mueller Gas Cocks.



B—755.

TOO little is not as much as you pay for, and too much is more paid for than you need.

In **Mueller Gas Cocks** you find a happy medium--not so little metal as to leave them weak, nor yet so much as to make them costly.

Made in 145 styles, seven sizes in each style.

MADE ONLY BY

H. MUELLER MFG. CO.,

DECATUR, ILLS., U. S. A.

THE

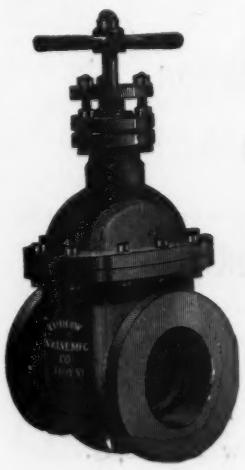
Ludlow Valve Mfg. Co.,

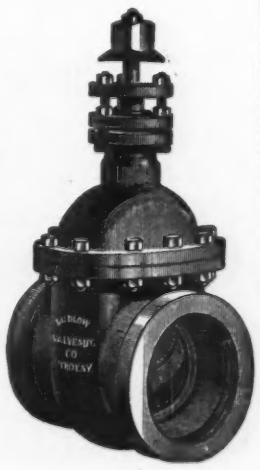
TROY, N. Y., U. S. A.

Double and Single Gate Valves, ⅛" to 72",

—FOR—

Gas, Water, Steam, Oil, Ammonia, Etc.





HOT GAS VALVES A SPECIALTY.

Send for Catalogue.

"THE MINER"

Globe Street and Boulevard Lamps.

Cheapest and Best.

THOUSANDS IN USE WITH INCANDESCENT BURNERS.

Send for Catalogues.

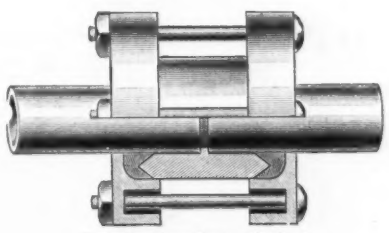
THOMAS T. W. MINER,

821-823 Eagle Av., N.Y.

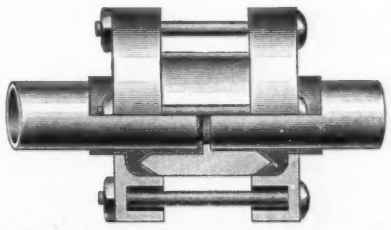
S. R. DRESSER,

BRADFORD, PENNSYLVANIA, U. S. A.,

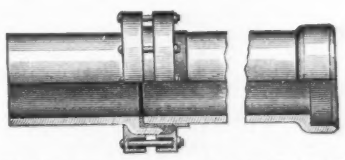
Patentee and Manufacturer of Specialties for Oil and Gas Lines.



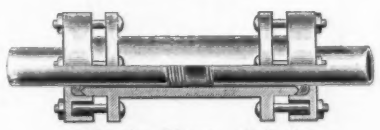
Regular Coupling. Style 1.



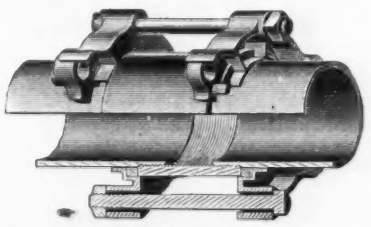
Insulating Coupling for Wrought Iron Pipe. Style 5.



Insulating Coupling for Dresser Bell and Spigot Cast Iron Pipe. Style 6.



Regular Sleeve. Style 2.



Clamp. Style 4.

Pipe Couplings, Sleeves, Clamps, Crosses, Tees and Ells.

My Insulating Coupling prevents the destruction of pipe by electrolytic action, in either water or gas lines.

SEND FOR CATALOGUE.

LLOYD CONSTRUCTION COMPANY,

DETROIT, MICH.

LOWE DOUBLE SUPERHEATER WATER GAS APPARATUS.

Coal Gas Condensing and Scrubbing Apparatus.
Purifiers with Plain or Reversing Center Valves.
The Lloyd System of Valve Connections.
PLAIN OR REVERSING (PATENT APPLIED FOR).
Oxide, Coal and Coke Elevators and Machinery.
Pipe Specials, all sizes. A. G. L. Asn. Standard.
Structural Steel Work, Floors, Angle and Gate Valves.

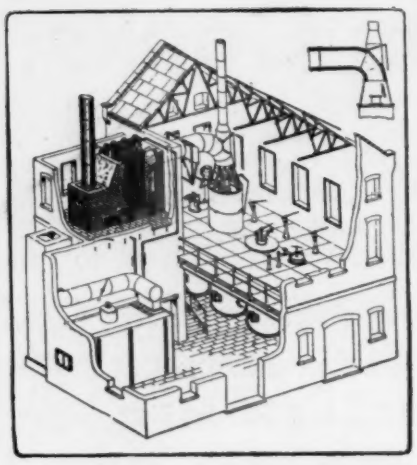
General Western Agents for BARTLETT, HAYWARD & CO., Baltimore, Md.

COAL GAS CONDENSATION SYSTEM. THE "MAYER" PATENTED TAR EXTRACTOR. THE STANDARD ROTARY WASHER-SCRUBBER. STETTIN SYSTEM INCLINED BENCHES, HYDRAULIC VALVES, ETC., ETC.

Economize Heat in Water Gas Plants,

BY UTILIZING A

Green's Economizer,



To absorb the heat now going to waste when you blow through your superheater to heat the feed water for your boilers to the temperature of the steam. This is now being done at the Poughkeepsie Gas Works, Poughkeepsie, N. Y. : : : : :

Write for full particulars how this is accomplished, the saving effected, and the advantages gained, to the

GREEN FUEL ECONOMIZER CO.,
MATTEAWAN, N. Y.

GASHOLDER TANKS AND GAS WORKS MASONRY COMPLET

Plans prepared and Estimates furnished at short notice

J. P. WHITTIER,
238 Java Street, Brooklyn, N. Y.

GEORGE R. ROWLAND,

Formerly with the Continental Iron Works.

Draughtsman and Constructing Engineer.

Drawings, Specifications and Estimates furnished for the construction of new works or alteration of old works. Special attention given to Patent Office drawings.

Office, No. 245 Broadway, N. Y. City

Chollar's System of Gas Purification.

THE PURIFIED GAS REVIVES THE FOULED OXIDE.

THE GAS ENGINEERS' POCKET-BOOK.

By Henry O'Connor,

Comprising Tables, Notes and Memoranda relating to the Manufacture, Distribution and Use of Coal Gas, and the Construction of Gas Works.

PRICE, $3.50.

A. M. CALLENDER & CO., No. 42 Pine Street, New York City.

The Advertisement of the

P. H. & F. M. ROOTS CO., Mfrs. of Gas Exhausters, Blowers, etc.,

Connersville, Ind., = = = 120-122 Liberty Street, New York City,

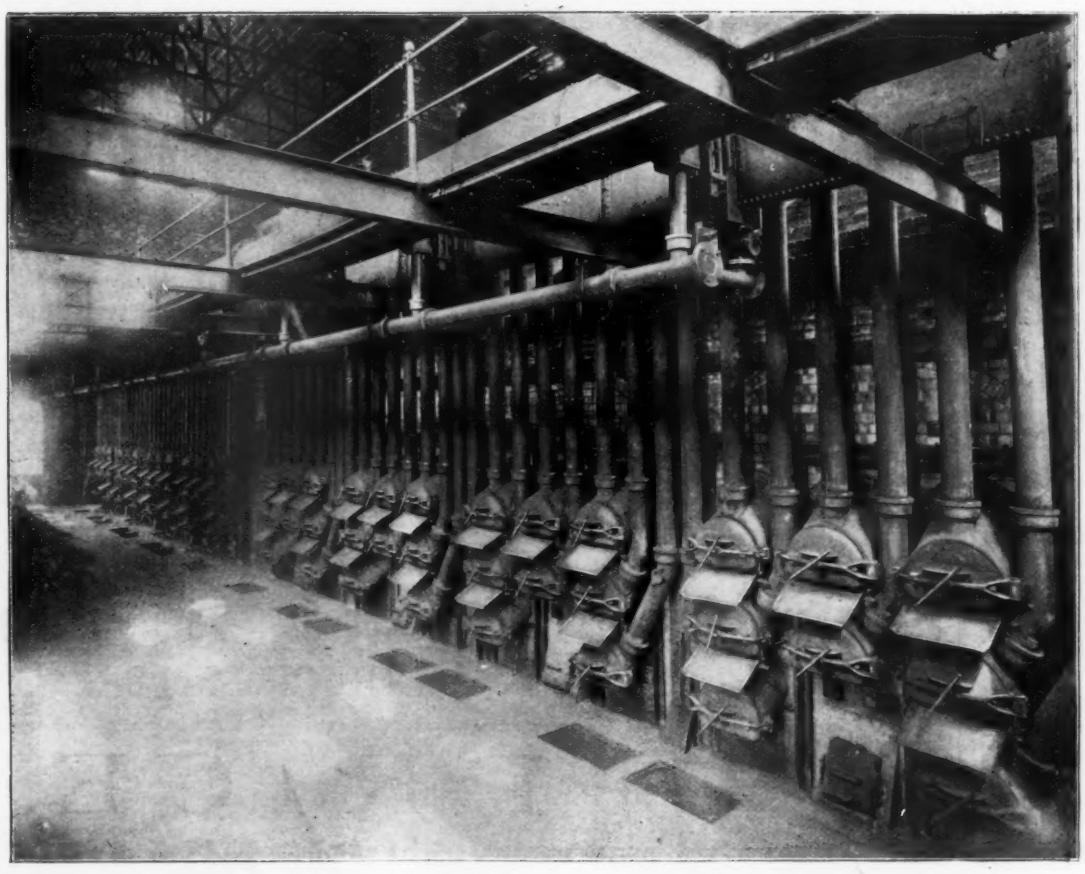
Occupies this Space Every Alternate Week.

Connelly Iron Sponge and Governor Co.,

395 Broadway, New York City.

TELEPHONE, 3033 Franklin. - - - CABLE ADDRESS, Governorco.

GEO. G. RAMSDELL, General Manager. S. F. HAYWARD, Treasurer.



DRAKE'S
System of
INCLINED or
HORIZONTAL
RETORTS.

Erected on
Guaranteed
Results.

Also Complete
COAL and COKE
HANDLING
MACHINERY.

Gas Exhausters,
Gas Governors,
Photometers,
Iron Sponge,
Revivifying Air Device,
Gas Specialties.

CONTRACTORS FOR EVERY KIND OF GAS WORKS PLANT.

"Globe Specials" "Glamorgan" Pipe Fittings, etc.

M. J. DRUMMOND & CO.

MANUFACTURERS OF

CAST IRON FLANGE GAS AND WATER PIPE

GENERAL SALES OFFICE, 192 BROADWAY, NEW YORK.

GEORGE ORMROD, Manst. & Treas., Emaus, Pa.
JOHN DONALDSON, Prest., Betz Bldg., Phila., Pa.

EMAUS PIPE FOUNDRY.

DONALDSON IRON COMPANY. EMAUS, PA.

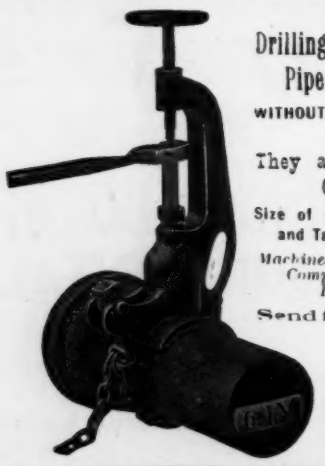
MANUFACTURERS OF

CAST IRON PIPE AND SPECIAL CASTINGS

FOR WATER AND GAS.

Also, FLANGE PIPE, LAMP POSTS, Etc.

GAS TAPPING MACHINES



—FOR—

Drilling and Tapping Pipe under Pressure

WITHOUT ANY ESCAPE OF GAS.

They are Strong and Compact.

Size of Combination Drills and Taps ¾ to 4-inch.

Machines Sent to any Gas Company for Thirty Days' Trial.

Send for Circulars.

Geo. Light,
DAYTON, O.

THE ECONOMICAL GAS APPARATUS CONSTRUCTION COMPANY, LIMITED,

Consulting Engineers.

Builders of UP-TO-DATE Machinery and Appliances for Coal and Water Gas Plants. :: :: :: :: ::

PLANS, SPECIFICATIONS AND ESTIMATES PREPARED.

AMERICAN OFFICE:
269 Front St., East, Toronto, Canada.

THE

Valuation of Gas, Electricity and Water Works

FOR ASSESSMENT PURPOSES.

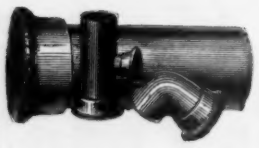
THOS. NEWBIGGING, M.Inst.C.E., and WM. NEWBIGGING, Assoc.M.Inst.C.E.

With an Appendix of Decided Cases.

Second Edition. Price $2. For Sale by

A. M. CALLENDER & CO.,
42 Pine Street, N. Y. City.

WARREN FOUNDRY AND MACHINE CO.,



Established 1856. Works at Phillipsburgh, N. J.

New York Office, 160 Broadway.

CAST IRON WATER AND GAS PIPE,

FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc.

CHARLES MILLAR & SON CO., Selling Agents, Utica, N.Y.

Flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, Jute, etc.

UTICA PIPE FOUNDRY CO.

Manufacturers of Lead Pipe, Solder, etc., and Jobbers of Plumbers' and Tinners' Goods.

CAST IRON PIPE and SPECIALS FOR WATER AND GAS

Wholesale Eastern Agents AKRON VITRIFIED SEWER PIPE.

SAFETY GAS MAIN STOPPER COMPANY,

For Shutting Off Gas in Mains

Any size gas main can be shut off in 30 seconds. : : :

Temporarily during alterations and repairs. : : : :

STOPPERS SENT ON TRIAL.

Address: SAFETY GAS MAIN STOPPER CO., 108 E. 117th St., New York City.

THE No. 8

Humphrey Crescent Instantaneous Water Heater

IS A QUICK SELLER.

PRICE,

$20.00.

SHELF AND BRACKET FREE.

HAS NO EQUAL AT THE PRICE.

TRY ONE AND BE CONVINCED. WILL SEND ON 60 DAYS' APPROVAL.

HAVE YOU OUR CATALOGUE?

The Humphrey Mfg. and Plating Co.,

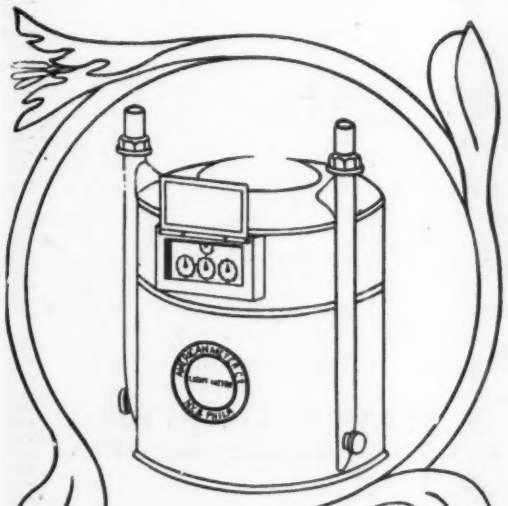
KALAMAZOO, MICH., U. S. A.

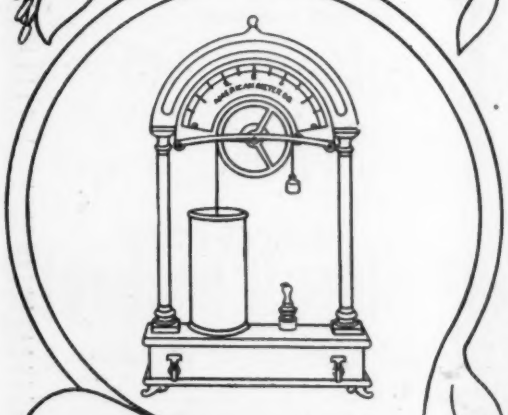
(Copyrighted, 1894, by the AMERICAN METER CO.)

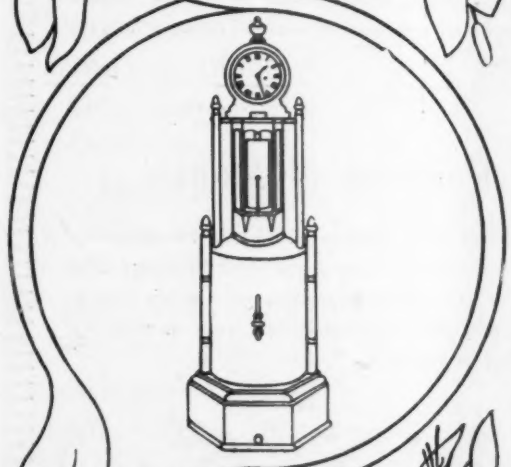
AMERICAN METER CO.

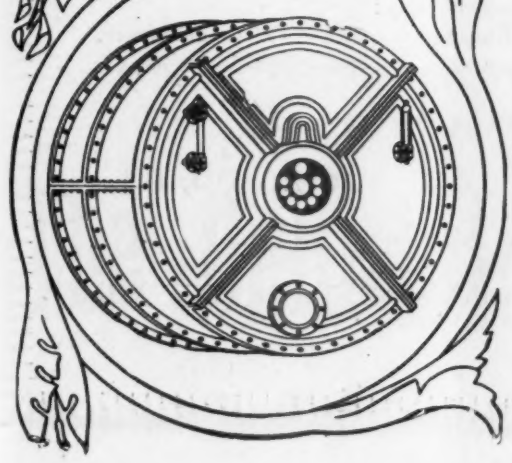
ESTABLISHED 1836. INCORPORATED 1868.

NEW YORK
PHILADELPHIA,
CHICAGO,
ST. LOUIS,
SAN FRANCISCO.





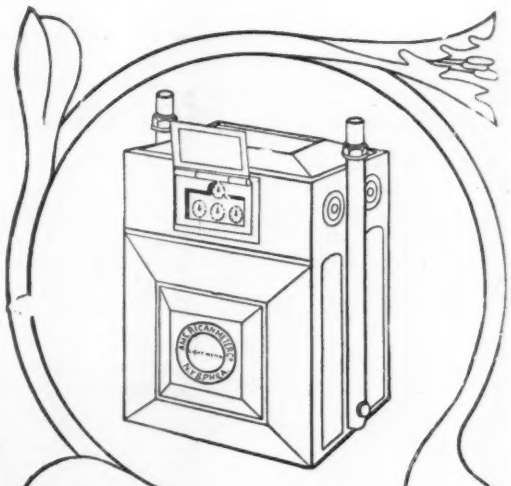


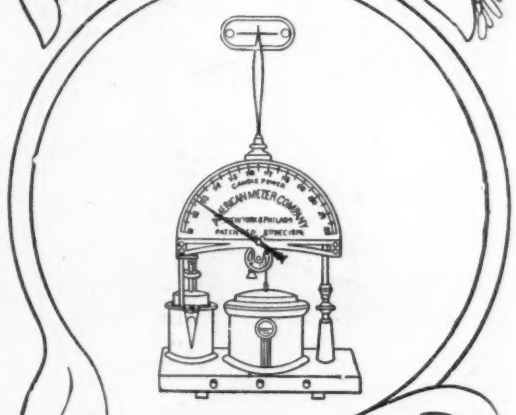


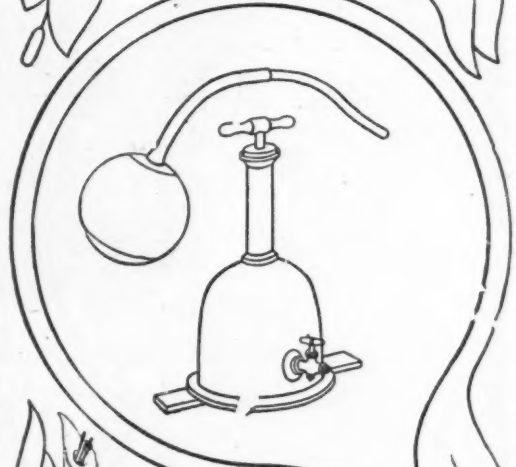
PUBLIC LIGHTING TABLE.

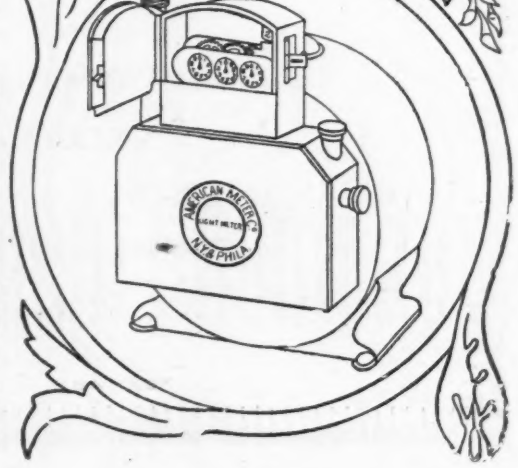
SEPTEMBER, 1903.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Tue.	1	12.30 AM	4.30 AM	6.30	4.20
Wed.	2	1.20	4.30	6.30	4.20
Thu.	3	2.10	4.30	6.15	4.30
Fri.	4	3.10	4.30	6.15	4.30
Sat.	5	No L.	No L.	6.15	4.30
Sun.	6	No L. FM	No L.	6.15	4 30
Mon.	7	No L.	No L.	6.15	4.30
Tue.	8	6.50 PM	8.10 PM	6.15	4.30
Wed.	9	6 50	8.40	6.15	4.30
Thu.	10	6.50	9.20	6.05	4.40
Fri.	11	6.50	10.00	6.05	4.40
Sat.	12	6.50	10.40	6.05	4.40
Sun.	13	6.40	11.30	6.05	4.40
Mon.	14	6.40 LQ	12.20 AM	6.05	4.40
Tue.	15	6.40	1.20	6.05	4.40
Wed.	16	6.40	2.30	6.05	4.40
Thu.	17	6.40	4.40	5.55	4.50
Fri.	18	6.40	4.40	5.55	4.50
Sat.	19	6.40	4.40	5.55	4.50
Sun.	20	6.30 NM	4.50	5.55	4 50
Mon.	21	6.30	4.50	5.55	4.50
Tue.	22	6.30	4.50	5.55	4.50
Wed.	23	6.30	4.50	5.55	4.50
Thu.	24	6.30	4.50	5.40	5.00
Fri.	25	8.00	4.50	5 40	5.00
Sat.	26	8.40	4.50	5.40	5.00
Sun.	27	9.30	4.50	5.40	5.00
Mon.	28	10.20 FQ	4.50	5.40	5.00
Tue.	29	11.10	4.50	5.40	5.00
Wed.	30	12.10 AM	4.50	5.40	5.00









TOTAL HOURS LIGHTING DURING 1903.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	245.00	January	423.20
February	192.00	February	355.25
March	201.00	March	355.35
April	167.20	April	298.50
May	152.00	May	264.50
June	131.00	June	234.25
July	140.40	July	243.45
August	156.20	August	280.25
September	171.20	September	321.15
October	198.20	October	374.30
November	216.30	November	401.40
December	232.10	December	433.45
Total, yr.	2203.40	Total, yr.	3987.45

No. 904 Welsbach Outdoor Arc

Furnished with 2, 3, 4 or 5 Burners

This Lamp is Built to Stand

rough usage and severe weather conditions. In mechanical construction and workmanship it is perfect.

The material is of the best. All exposed metal parts made of cold rolled sheet copper.

Guaranteed Positively

Rain-proof

Wind-proof

Insect-proof

The main cock lights one or all burners. Pilot flash light.

18-inch enameled steel reflector shade.

Long tube burners, with adjustable needle gas feed, permit use of either 3½-inch or 4½-inch mantles.

Renewal of Mantle

made easy and without danger of breakage by raising the body of the lamp on main stem. The neck of the globe thus acts as a wind guard, protecting the other mantles from damage by weather conditions.

Candle Power Test

of 4-burner lamp:

With 3½-inch mantles, 412-candle power.

With 4½-inch mantles, 503-candle power.

WELSBACH COMPANY,

GLOUCESTER, N. J. CHICAGO, ILL.

ORDERS ACCEPTED FOR SHIPMENT ON AND AFTER SEPTEMBER 15.

Sample Case of 3, 6 or 12 lamps sent on 30 days' approval at prices based on 100 lamps.

THE UNITED GAS IMPROVEMENT COMPANY

For the Six Months Ending July 1, 1903, has been Awarded Contracts in the Following Places for

Standard Double-Superheater Lowe Water Gas Apparatus.

Rochester, N. Y.	**Brooklyn, N. Y.**	**Waltham, Mass.**
Baltimore, Md.	**Hempstead, N. Y.**	**Dover, Del.**
Chicago, Ills.	**Chester, Pa.**	**Allentown, Pa.**
Amesbury, Mass.	**Lynn, Mass.**	**Savannah, Ga.**
Aberdeen, S. D.	**Newark, N. J.**	**New York** (Central Union Co.)
Winsted, Conn.	**Washington, D. C.**	**Cicero, Ills.**
Canon City, Col.	**Boone, Ia.**	**Chicago** (Ogden Co.)
Schenectady, N. Y.	**Pueblo, Col.**	**Easton, Pa.**
Hagerstown, Md.	**Charlotte, N. C.**	**Lawrence, Mass.**
Malden, Mass.	**Fall River, Mass.**	**Council Bluffs, Ia.**
Bridgeport, Conn.	**Duluth, Minn.**	**Chattanooga, Tenn.**
Albert Lea, Minn.	**New York** (Mutual Co.)	

TOTAL SETS TO JULY 1, 1903, ... 51
TOTAL DAILY CAPACITY, ... 55,150,000 cubic feet.
TOTAL SETS TO DATE, ... 498
TOTAL DAILY CAPACITY, ... 354,830,000 cubic feet.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia

Established 1858. Incorporated 1890.
CHAS. E. GREGORY, Prest. DAVID R. DALY, V.-Prest. & Treas.
H. D. ABERNETHY, Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
Jersey City, N. J.

MANUFACTURERS OF

CLAY GAS RETORTS, FIRE CLAY TILES,
FIRE BRICK and FIRE CLAY SPECIALTIES

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

SOLE MANUFACTURERS OF THE

FLEMMING GENERATOR GAS FURNACE

Brooklyn Fire Brick Works,

OFFICE AND WORKS:
88 VAN DYKE ST., BROOKLYN, N. Y.
MANUFACTURERS OF

CLAY GAS RETORTS & SETTINGS, GENERATOR LININGS. SPECIALTIES.

Established 1854. Incorporated 1869.

LACLEDE
Fire Brick Manufg. Co.,

Manufacturers of { GAS RETORTS . .
FIRE BRICK . . .
RETORT SETTINGS

Water Gas Cupola Linings, Fire Clay, Etc.

Proprietors for the U. S., Coze System of Inclined Benches.

Estimates Furnished on Application for Most Successful Style of Construction.

Also for Free-Firing and Full and Half-Depth Regenerative Benches, for Burning either Coal or Coke in the Furnaces.

Office:
Cor. Manchester and Sulphur Avenues, St. Louis, Mo.

Established 1845. Reorganized 1902.

The Kreischer Brick Mfg. Co,

Manufacturers of the very best quality of Clay Retorts, Blocks, Tiles, Settings and Firebrick of every description.

Also Miners and Shippers of Fireclay, Fire Sand, Ground Brick in Barrels.

WORKS: KREISCHERVILLE, STATEN ISLAND.
OFFICE: 119 E. 23D STREET, NEW YORK CITY.

Adam Weber Sons.

Works. Weber, N. J.
Main Offices, Park Row Bldg., New York.

Modern Recuperative Furnaces.

Standard Fire Brick and Gas Retorts.

OSCAR B. WEBER'S

Construction Vertical 8's (Patented). First Instalment in the World with Modern Charging and Discharging Machinery.

AGENTS FOR

GRAHAM, MORTON & CO.
LEEDS ENGLAND,
INCLINED RETORT SYSTEM.

Perforated Radial Block Chimneys.

AGENCIES.
HERBERT B. HAM, 80 Water Street, Boston, Mass.
BAKER ENGINE AND MACHINE CO., 114 N. 3d St., Phila., Pa
JOHN T. WHEELER, 933-934 Monadnock Bldg., Chicago, Ills

ISAAC C. BAXTER, President. ESTABLISHED 1864. PETER YOUNG, Sec'y and Treas.

Works
LOCKPORT STATION, PA.

JAMES GARDNER, JR., CO.,

Address all communications to
JAMES GARDNER, JR., CO., Room 202 Lewis B'l'dg
PITTSBURGH, PA

Successor to WILLIAM GARDNER & SON.

Fire Clay Goods for Gas Works.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY

RETORT WORKS

WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y.

Clay Gas Retorts,
BENCH SETTINGS,
Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

Price List, f.o.b. Galesburg, Ills., or Buffalo, N. Y.
In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD, Galesburg, Ills.

For orders East of Buffalo, N. Y., or Pittsburg, Pa., freight will be paid to these points.

The Gas Engineer's Pocket-Book,

By HENRY O'CONNOR.

Comprising Tables, Notes and Memoranda relating to the Manufacture, Distribution and Use of Coal Gas, and the Construction of Gas Works.

PRICE, $3.50.

For Sale by

A. M. CALLENDER & CO., 42 Pine Street, New York City.

THEO. J. SMITH, Prest. J. A. TAYLOR, Sec.
A. LAMBLA, Vice-Prest. and Supt.

BALTIMORE
RETORT & FIRE BRICK CO.

MANUFACTORY AT
LOCUST POINT, BALTIMORE, MD.

Clay Retorts, Blocks & Tiles

FIRE BRICK, FIRE CLAY, AND FIRE CEMENT

Our Improved Half and Full Dept Benches have been Adopted by Many Gas Companies.

WALDO BROS., 102 MILK ST., BOSTON, MASS.

Sole Agents for New England States.

JOHN DELL,
President and General Manager.

MISSOURI FIRE BRICK CO.,

ESTABLISHED 1882.

MANUFACTURERS OF

Gas Retorts, Bench Settings, Fire Brick, Cupola Linings, Etc.

We are the Exclusive Agents *for the* Mitchell Patent Benches, *Constructed with Half or Full Depth Furnaces, to Burn either Coal or Coke, and Arranged for Front or Rear Clinkering. The* Mitchell *is the* Original Coal Firing Bench. *We also Erect Plain Benches with One to Six* Retorts.

YOUR CORRESPONDENCE IS RESPECTFULLY SOLICITED.

City Office:
411 Olive Street,
Continental Bank,
ST. LOUIS, MO.

CHRISTOPHER CUNNINGHAM,

PROPRIETOR,

THE NOVELTY STEAM BOILER WORKS,

BROOKLYN, N. Y.

STORAGE TANKS FOR GAS WORKS,

To Retain Fluid Material of Any Sort.

PIPING IN AND AROUND GAS WORKS.

Work Done for Several of the Largest Gas Companies in America Stands as Reference.

Bronder Patent Stoking Machinery.

Three-Scoop and Three-Rake Charging and Discharging Machines are operating in New York, Newark, N. J., Philadelphia, Worcester, Mass., Mt. Vernon, N. Y., Toronto and Montreal, Canada.

Four-Scoop and Four-Rake Charging and Discharging Machines are being furnished for Detroit, Mich.

These are the only machines that will draw or charge simultaneously three or four retorts (vertically) and handle from 42 to 60 retorts in from 25 to 30 minutes, lid opening and closing and filling of furnaces included.

Hot Coke Conveyor, Quencher and Steam Exhauster, operating in Toronto, Can., working in water-sealed flue, rollers being protected from heat and grit.

COAL CRUSHERS, CONVEYORS AND BINS. TURNTABLES FOR MACHINES.

Labor-Saving Machines for Handling Coal and Coke from Coal Cars to Coke Yard or Bins, a Specialty.

G. A. BRONDER,

Contracting Engineer and Builder,

229 BROADWAY, NEW YORK.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY, Prest. DAVID R. DALY, V.-Prest. & Treas.
H. D. ABERNETHY, Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
Jersey City, N. J.

MANUFACTURERS OF

CLAY GAS RETORTS, FIRE CLAY TILES,
FIRE BRICK and FIRE CLAY SPECIALTIES

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

SOLE MANUFACTURERS OF THE

FLEMMING GENERATOR GAS FURNACE

Brooklyn Fire Brick Works,

OFFICE AND WORKS:
88 VAN DYKE ST., BROOKLYN, N. Y.
MANUFACTURERS OF

CLAY GAS RETORTS & SETTINGS, GENERATOR LININGS. SPECIALTIES.

Established 1854. Incorporated 1869.

LACLEDE
Fire Brick Manufg. Co.,

Manufacturers of { GAS RETORTS . .
FIRE BRICK . . .
RETORT SETTINGS

Water Gas Cupola Linings, Fire Clay, Etc.

Proprietors for the U. S., Coze System of Inclined Benches.

Estimates Furnished on Application for Most Successful Style of Construction.

Also for Free-Firing and Full and Half-Depth Regenerative Benches, for Burning either Coal or Coke in the Furnaces.

Office:
Cor. Manchester and Sulphur Avenues, St. Louis, Mo.

Established 1845. Reorganized 1902.

The Kreischer Brick Mfg. Co,

Manufacturers of the very best quality of Clay Retorts, Blocks, Tiles, Settings and Firebrick of every description.

Also Miners and Shippers of Fireclay, Fire Sand, Ground Brick in Barrels.

WORKS: KREISCHERVILLE, STATEN ISLAND.
OFFICE: 119 E. 23D STREET, NEW YORK CITY.

Adam Weber Sons.

Works. Weber, N. J.
Main Offices, Park Row Bldg., New York.

Modern Recuperative Furnaces.

Standard Fire Brick and Gas Retorts.

OSCAR B. WEBER'S

Construction Vertical 8's (Patented).
First Instalment in the World with Modern Charging and Discharging Machinery.

AGENTS FOR

GRAHAM, MORTON & CO.
LEEDS ENGLAND,
INCLINED RETORT SYSTEM.

Perforated Radial Block Chimneys.

AGENCIES.
HERBERT B. HAM, 80 Water Street, Boston, Mass.
BAKER ENGINE AND MACHINE CO., 114 N. 3d St., Phila., Pa
JOHN T. WHEELER, 933-934 Monadnock Bldg., Chicago, Ills

ISAAC C. BAXTER, President. ESTABLISHED 1864. PETER YOUNG, Sec'y and Treas.

Works
LOCKPORT STATION, PA.

JAMES GARDNER, JR., CO.,

Address all communications to
JAMES GARDNER, JR., CO., Room 202 Lewis B'l'dg
PITTSBURGH, PA

Successor to WILLIAM GARDNER & SON.

Fire Clay Goods for Gas Works.

HENRY MAURER & SON,
(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY
RETORT WORKS

WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y.

Clay Gas Retorts,
BENCH SETTINGS,
Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

Price List, f.o.b. Galesburg, Ills., or Buffalo, N. Y.
In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD, Galesburg, Ills.

For orders East of Buffalo, N. Y., or Pittsburg, Pa., freight will be paid to these points.

The Gas Engineer's Pocket-Book,

By HENRY O'CONNOR.

Comprising Tables, Notes and Memoranda relating to the Manufacture, Distribution and Use of Coal Gas, and the Construction of Gas Works.

PRICE, $3.50.

For Sale by

A. M. CALLENDER & CO., 42 Pine Street, New York City.

THEO. J. SMITH, Prest. J. A. TAYLOR, Sec.
A. LAMBLA, Vice-Prest. and Supt.

BALTIMORE
RETORT & FIRE BRICK CO.

MANUFACTORY AT
LOCUST POINT, BALTIMORE, MD.

Clay Retorts, Blocks & Tiles

FIRE BRICK, FIRE CLAY, AND FIRE CEMENT

Our Improved Half and Full Dept Benches have been Adopted by Many Gas Companies.

WALDO BROS., 102 MILK ST., BOSTON, MASS.

Sole Agents for New England States.

JOHN DELL,
President and General Manager.

MISSOURI FIRE BRICK CO.,

ESTABLISHED 1882.

MANUFACTURERS OF

Gas Retorts, Bench Settings, Fire Brick, Cupola Linings, Etc.

We are the Exclusive Agents *for the* Mitchell Patent Benches, *Constructed with Half or Full Depth Furnaces, to Burn either Coal or Coke, and Arranged for Front or Rear Clinkering.* The Mitchell *is the* Original Coal Firing Bench. *We also Erect Plain Benches with* One *to* Six Retorts.

YOUR CORRESPONDENCE IS RESPECTFULLY SOLICITED.

City Office:
411 Olive Street,
Continental Bank,
ST. LOUIS, MO.

CHRISTOPHER CUNNINGHAM,

PROPRIETOR,

THE NOVELTY STEAM BOILER WORKS,

BROOKLYN, N. Y.

STORAGE TANKS FOR GAS WORKS,

To Retain Fluid Material of Any Sort.

PIPING IN AND AROUND GAS WORKS.

Work Done for Several of the Largest Gas Companies in America Stands as Reference.

Bronder Patent Stoking Machinery.

Three-Scoop and Three-Rake Charging and Discharging Machines are operating in New York, Newark, N. J., Philadelphia, Worcester, Mass., Mt. Vernon, N. Y., Toronto and Montreal, Canada.

Four-Scoop and Four-Rake Charging and Discharging Machines are being furnished for Detroit, Mich.

These are the only machines that will draw or charge simultaneously three or four retorts (vertically) and handle from 42 to 60 retorts in from 25 to 30 minutes, lid opening and closing and filling of furnaces included.

Hot Coke Conveyor, Quencher and Steam Exhauster, operating in Toronto, Can., working in water-sealed flue, rollers being protected from heat and grit.

COAL CRUSHERS, CONVEYORS AND BINS. TURNTABLES FOR MACHINES.

Labor-Saving Machines for Handling Coal and Coke from Coal Cars to Coke Yard or Bins, a Specialty.

G. A. BRONDER,

Contracting Engineer and Builder,

229 BROADWAY, NEW YORK.

JAMES D. PERKINS, President. F. SEAVERNS, Treasurer.

THE PERKINS COMPANY,

228 and 229 Produce Exchange, New York City.

TIDEWATER SALES AGENTS FOR THE FOLLOWING:

Ocean Mine Youghiogheny Gas Coal,
Old Kentucky Shale and O. K. Boghead.

SHIPMENTS FROM NEW YORK, PHILADELPHIA, BALTIMORE AND NORFOLK.

BERWIND-WHITE COAL MINING COMPANY'S

Ocean Westmoreland Gas Coal.

Offices:
Washington Building, New York.
Betz Building, Philadelphia.

STRICTLY High Grade. . . . .
Carefully Prepared.
For Gas Making or
Heavy Steaming. .

A. G. M. AZOY, General Agent, 1 Broadway, New York.

THE GAS ENGINEER'S POCKET-BOOK,

By HENRY O'CONNOR,

Comprising Tables, Notes and Memoranda relating to the Manufacture, Distribution and Use of Coal Gas, and the Construction of Gas Works.

PRICE, $3.50.

FOR SALE BY

A. M. CALLENDER & CO., - No. 42 Pine Street, New York City.

POOLE ON FUELS.

THE CALORIFIC POWER OF FUELS.

WITH A VERY FULL COLLECTION OF TABLES OF HEATS OF COMBUSTION OF FUELS, SOLID, LIQUID AND GASEOUS.

TO WHICH IS ALSO APPENDED

THE REPORT OF THE COMMITTEE ON BOILER TESTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, DECEMBER (1897); TABLES OF CONSTANTS USED.

By HERMAN POOLE, F.C.S.

Second Edition. Price $8. For Sale by

A. M. CALLENDER & CO. - - No. 42 Pine Street, New York City.

KELLER ADJUSTABLE COKE CRUSHER.

Strong, Simple, Durable. Will Crush any Size Desired.

C. M. KELLER,
Sec. & Supt. Gas Lt. & Coke Co.,
Columbus, Ind.
Correspondence Solicited.

Do You Wish to Know

what size of pipe to use to convey any quantity of gas, any distance, with any loss of pressure and any initial or final pressure? Then use

Cox's Gas Flow Computer,

as it gives this information accurately at sight, without mental effort. No calculations needed. Saves time, money and mistakes.

Price, 6.5 x 8 inches, in cloth case, $2.50
For sale by

A. M. Callender & Co., 42 Pine St., N. Y.

POOLE ON FUELS.

THE CALORIFIC POWER OF FUELS.

By HERMAN POOLE, F.C.S.

Second Edition. Price, $3. For Sale by

A. M. CALLENDER & CO., 42 PINE ST., N.Y. CITY.

BINDER for the JOURNAL.

Price, $1.00.

A. M. CALLENDER & CO., 42 Pine Street, N.Y.

EDMUND H. McCULLOUGH, President. CHAS. F. GODSHALL, Treasurer. H. C. ADAMS, Secretary. HENRY WHARTON, Assistant Secretary.

THE WESTMORELAND COAL CO.

Chartered 1854.

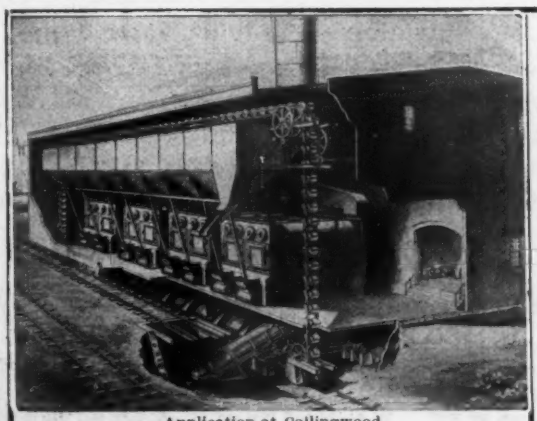
Mines situated on the Pennsylvania and the Baltimore and Ohio Railroads, in Westmoreland County, Pa.

POINTS OF SHIPMENT:

PHILADELPHIA, BALTIMORE, SOUTH AMBOY, N. J.,
WATKINS (SENECA LAKE), N. Y.

Since the commencement of operations by this Company its well-known Coal has been largely used by the Gas Companies of New England and the Middle States, and its character is established as having no superior in gas-giving qualities, and in freedom from sulphur and other impurities.

Principal Office, 224 South 3d St., Phila., Pa.



Application at Collingwood.
Shops L. S. & M. S. R. R., Cleveland, O.

LINK-BELT
Overlapping
PIVOTED BUCKET CARRIER.

(PATENTED.)

A single machine will handle both coal and ashes in boiler room. It is automatic, efficient, durable, occupies little space, and saves money. Can be adapted to a wide range of special conditions. : : : : : : :

Link-Belt Machinery Co.,

LINK-BELT ENGINEERING CO., Philadelphia. Chicago.

THE SUN OIL CO.

Crude Oil, Gas Naphtha,
Refined Petroleum, Gas Oil.

Toledo, O., and Pittsburgh, Pa.

Standard Oil Company,

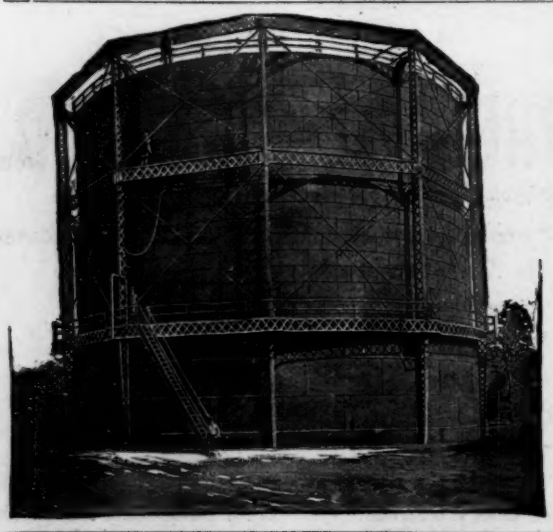
GAS NAPTHA DEPARTMENT.

GAS NAPTHA.

GAS OIL.

Correspondence Solicited.

26 Broadway, New York City.



DAVIS & FARNUM MFG. CO.,

WALTHAM, MASS.

Principal Office & Works, Waltham, Mass. Boston Office, R'm 18, Vulcan Bldg., 8 Oliver St.

Single, Double and Triple-Lift Gasholders of any Capacity. Tubular, Pipe and Sinuous Friction Condensers of all Sizes.

Steel Tanks for Gasholders, Iron Roof Frames and Floors, Purifying Boxes, Center Seal or Valve Connections, Bench Work, Reversible Lime Trays.

Self-Sealing and Pressed Steel Mouthpiece Lids.

Coke Barrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Works.

Also, Gas and Water Pipe, Flanged Pipe, Sugar House Work, and Special Castings of all Descriptions.

BAXTER & YOUNG,

CONTRACTING AND CONSULTING GAS ENGINEERS.

Examination and Values Ascertained of Artificial and Natural Gas Properties.

COMPLETE GAS WORKS ERECTED.

Artificial and Natural Gas Mains Furnished and Laid.

GAS PROPERTIES PURCHASED.

OFFICE: WAYNE COUNTY BANK BUILDING,

Rooms 201 & 202. DETROIT, MICH.

A. E. BOARDMAN, C. E.,

Consulting and Contracting Engineer.

Particular attention given to Gas, Water and Electric Plants. Long and successful experience with the problem and practice of

Filtration for Public Water Supply.

Edison Building, 42 and 44 Broad St.,

NEW YORK CITY.

Geo. Shepard Page's Sons.

GAS MACHINERY.

Correspondence Solicited.

180 Fulton Street, New York City.

DAVID LEAVITT HOUGH,

Consulting Engineer

AND

CONTRACTOR,

PARK ROW BUILDING, N. Y.

Practical Photometry,

By William Joseph Dibdin.

Price, - - - - $3.00.

FOR SALE BY

A. M. CALLENDER & CO.,

No. 42 Pine Street, New York City.

KERR MURRAY MANUFACTURING COMPANY,

Engineers and Manufacturers

APPARATUS FOR COAL GAS PLANTS,

SINGLE AND DOUBLE-LIFT GASHOLDERS AND STEEL TANKS,

Latest Improved

ROTARY EXHAUSTERS, P. & A. TAR EXTRACTORS, AMMONIA WASHERS,

CONDENSING, SCRUBBING AND PURIFYING APPARATUS.

Street Specials and Valves.

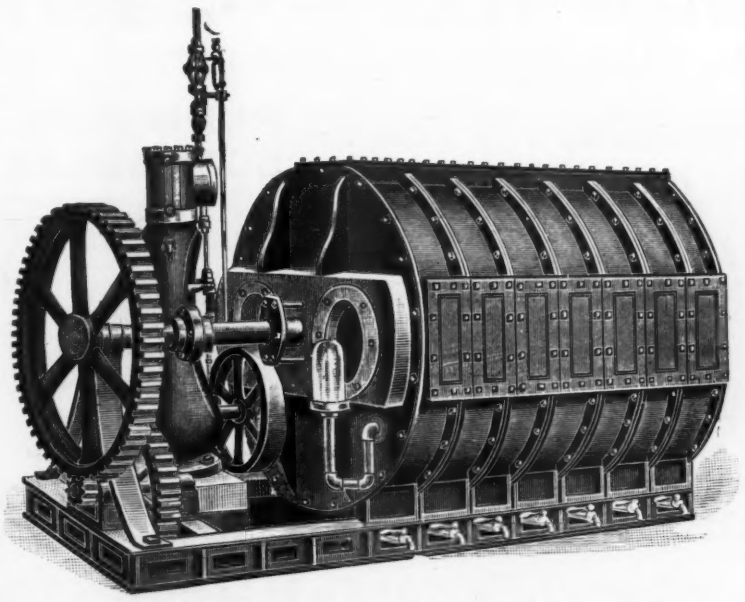
ADDRESS:

KERR MURRAY MANUFACTURING COMPANY, {FORT WAYNE, IND.

BARTLETT, HAYWARD & CO.

BALTIMORE, MD.

Designers and Builders of Gas Works.



Sole Lessees the Wilkinson Water Gas Process.

PATENT STANDARD WASHER-SCRUBBER.

The best apparatus for the extraction of all Ammonia and a large proportion of Carbonic Acid and Sulphureted Hydrogen. The Scrubber has been materially improved and is provided with patented Wooden Segmental Grids, instead of Metallic Discs, thus reducing the weight on shaft and power for operating same.

Coal and Water Gas Installations of the Most Modern and Complete Types.

BENCHES WITH INCLINED RETORTS.

System Stettiner Chamotte Fabrik, Actien Gesellschaft, of Stettin, Germany.

GASHOLDERS OF ALL SIZES.

General Western Agents, THE LLOYD CONSTRUCTION CO., of Detroit, Mich.

QUINTARD IRON WORKS,

N. F. PALMER,

Foot of 12th St. & East River, New York,

MANUFACTURERS OF

GAS APPARATUS.

Complete Works Erected.

FREDERICK W. FLOYD, Engineer.

ALEX. C. HUMPHREYS, M.E., M. Inst. C.E. ARTHUR G. GLASGOW, M.E., M. Inst. C.E.

HUMPHREYS & GLASGOW,

BANK OF COMMERCE BLDG., 31 Nassau Street, New York.

38 VICTORIA STREET, London S.W., England.

CONSULTING GAS AND ELECTRIC LIGHT ENGINEERS.

PROPERTIES PURCHASED.

COMPLETE EXAMINATIONS MADE.

R. D. WOOD & CO.,

400 CHESTNUT ST., PHILADELPHIA.

MANUFACTURERS OF

Cast Iron Pipe.

HEAVY LOAM CASTINGS,

Dunham Specials,

Hydraulic Work,

LAMP POSTS, VALVES, ETC.,

Gas Power Plants with Producers.

BUILDERS OF

Gasholders.

Single, Double and Triple Lifts, with or without Metal Tanks.

PURIFIERS, CONDENSERS, SCRUBBERS, BENCH WORK.

Cutler's Patent Freezing Preventer for Holder Cups.

ISBELL-PORTER CO.,

ENGINEERS AND CONTRACTORS FOR THE

Construction and Extension of Gas Works.

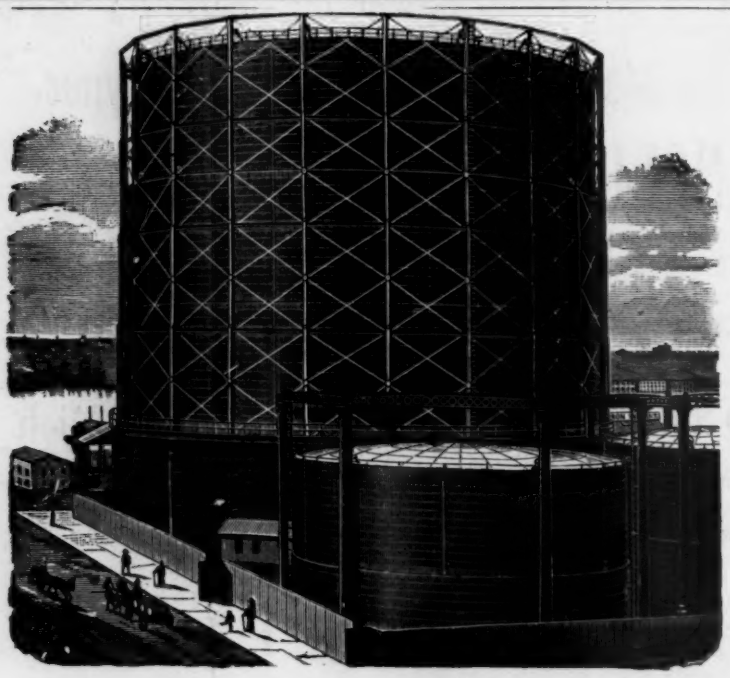
FOUNDERS AND MACHINISTS.

MANUFACTURERS OF

All Ironwork and Machinery Required in a Gas Plant.

Estimates, Drawings and Specifications furnished for the Alteration, Improvement, or Extension of Existing Works or the Construction of New Works.

245 Broadway, New York City. —OFFICES— **Bridge & Ogden Sts., Newark, N. J.**



The Continental Iron Works,

THOMAS F. ROWLAND, President.
WARREN E. HILL and CHAS. H. CORBETT, Vice-Presidents.
THOMAS F. ROWLAND, Jr., Secretary & Treasurer.

West and Calyer Sts. (Near 10th & 23d St. Ferries)
NEW YORK, Borough of Brooklyn.

BUILDERS OF

Gas Holders.

Single and Multiple Section Gas Holders a Specialty.

STEEL GAS HOLDER TANKS.

BENCH CASTINGS, RETORT LIDS.

Hydraulic Mains, Condensers, Scrubbers, Purifiers, Valves, Etc.

Self-Sealing Retort Mouthpieces & Lids

For Round, Oval, or "D" Retorts.

THE GAS ENGINEER'S LABORATORY HANDBOOK,

By JOHN HORNBY, F.I.C.

PRICE, - - - - - - - $2.50.

A. M. CALLENDER & CO., No. 42 Pine Street, New York City.

THE STACEY MANUFACTURING CO.,

MANUFACTURERS OF

Gasholders, Steel Tanks,

AND ALL IRONWORK & MACHINERY REQUIRED IN A GAS PLANT.

ALSO THE ONLY AUTHORIZED MANUFACTURERS OF

The Chollar System of Gas Purification.

OFFICES:

No. 239 Mill Street, CINCINNATI, OHIO. 'Phone, West 690.

PLANS, SPECIFICATIONS AND ESTIMATES CHEERFULLY FURNISHED.

RITER-CONLEY MFG. CO.,

GASHOLDERS, with or without Steel Tanks.

Purifiers, Condensers, Scrubbers, Oil Tanks, Smoke Stacks

STEEL ROOFS and BUILDINGS.

PLATE AND STRUCTURAL WORK OF EVERY DESCRIPTION.

GENERAL OFFICE: Pittsburg, Pa. EASTERN OFFICE: 39-41 Cortlandt St., New York City.

WM. HENRY WHITE,

EDISON BUILDING, No. 44 BROAD STREET, = = = NEW YORK CITY.

ENGINEER AND CONTRACTOR FOR THE

ERECTION AND EXTENSION OF

GAS, WATER, AND ELECTRIC LIGHT WORKS.

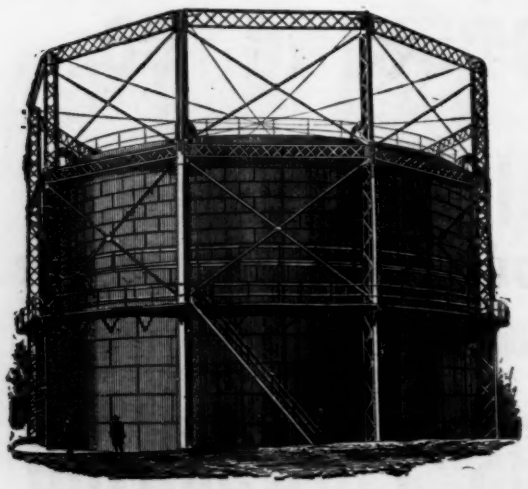
Correspondence with Gas Companies contemplating extending or improving their Plants respectfully invited
Plans and Estimates Furnished.

1902 DIRECTORY - 1902

OF AMERICAN GAS COMPANIES.

Price, - - - - - - - - - $5.00.

A. M. CALLENDER & CO., - - No. 42 Pine Street, New York.



1842 ※ Deily & Fowler, ※ 1903

LAUREL IRON WORKS.

Office, No. 39 Laurel Street, Philadelphia, Pa.

BUILDERS OF

Gasholders

Single or Telescopic. With or Without Iron or Steel Tanks.

OIL TANKS, WATER TANKS, AND GENERAL WROUGHT IRON WORK.

The order for this Triple-Lift Holder and Steel Tank was received by the Logan Iron Works from the Union Gas Light Company, of East New York. The contract was completed and the Holder was in actual use in 90 days from receipt of order. Capacity of Holder, 500,000 Cu.Ft.

LOGAN IRON WORKS,

Brooklyn, N. Y.

MANUFACTURERS OF

Single or Multiple-Lift

GASHOLDERS,

Complete with Steel Tanks.

BENCHES, SCRUBBERS,

CONDENSERS,

PURIFIERS, IRON ROOFS,

Self-Sealing Retort Lids,

AND ALL PARTS OF

GAS WORKS APPARATUS.

Contractors for Complete Works.

ALSO, SOLE MANUFACTURERS OF

C. W. BLODGET'S

HOT GAS SCRUBBER.

Gas Analyst's Manual,

By JAQUES ABADY, M. Inst. Mech. E.

(Incorporating F. W. Hartley's "Gas Analyst's Manual" and "Gas Measurement.")

Ninety-three Illustrations and Nine Folding Plates.

Bound in Handsome Half Leather. Price, - $6.50.

FOR SALE BY

A. M. CALLENDER & CO., - - . 42 Pine Street, New York City.

Established 1854.

D. McDONALD & CO.,

MANUFACTURERS OF

WET AND DRY METERS, STATION METERS AND METER PROVERS.

ALSO MAKERS OF

THE GLOVER PREPAYMENT METER.

The amount of gas delivered for the coin can be instantly and positively changed without removing the meter or replacing any parts.

The gas registered agrees absolutely with the amount purchased by the coin.

WE HAVE MADE AND SOLD IN THE UNITED STATES

OVER 120,000 OF THESE METERS,

ALL OF WHICH ARE GIVING PERFECT SATISFACTION.

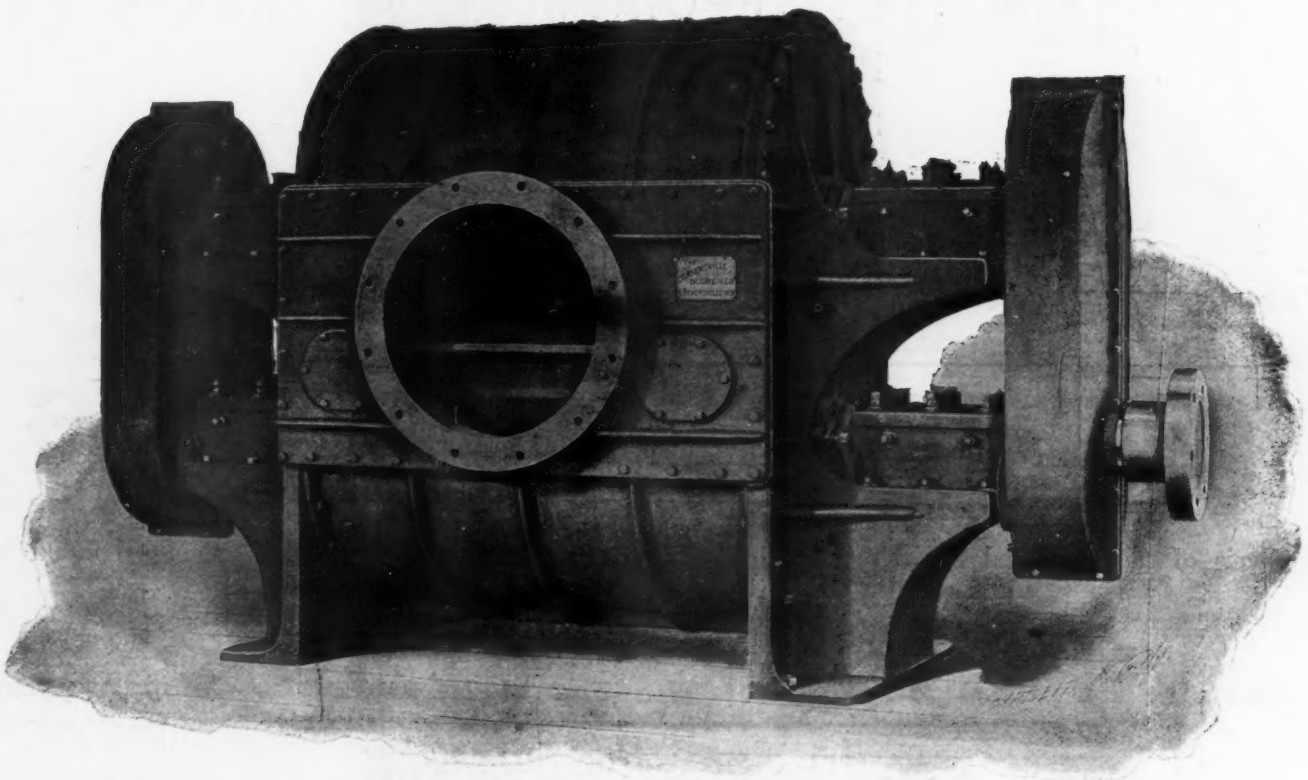
Correspondence Solicited.

561 West Forty-seventh Street, NEW YORK. | 51, 53 & 55 Lancaster Street, ALBANY, N. Y. | Jefferson and Monroe Streets, CHICAGO.

THE CONNERSVILLE BLOWER CO.,

MANUFACTURER OF

ROTARY POSITIVE PRESSURE GAS EXHAUSTERS, BLOWERS AND PUMPS.



HORIZONTAL OR VERTICAL, IN CAPACITY RANGING FROM 9,000 to 1,800,000 CU. FEET DISPLACEMENT PER HOUR.

CONNERSVILLE BLOWER CO., Connersville, Ind. EASTERN SALES OFFICE: 95-97 Liberty St., New York City.

NATHANIEL TUFTS METER CO.,

ESTABLISHED 1849.

8 MEDFORD STREET, BOSTON, MASS.

Consumers' Dry Gas Meters.
Station Meters of Any Capacity.

PREPAYMENT GAS METERS.

MARYLAND METER CO.,

BALTIMORE, North and Saratoga Streets. CHICAGO, 88 to 92 Jackson Boulevard

CONSUMERS' AND STATION METERS, PRESSURE GAUGES, ETC.

SPECIAL ATTENTION GIVEN TO ALL REPAIR WORK.

"Have you Seen our Complaint Meter?"

USING KEYSTONE METERS

IS FRAUGHT WITH NO
DISAPPOINTMENTS.
PERFECTLY MADE.
PERFECT MEASUREMENT
GUARANTEED.

THE KEYSTONE METER COMPANY,

ROYERSFORD, PA.

FIELD'S ANALYSIS
For the Year 1902.

An Analysis of the Principal Gas Undertakings in England, Scotland and Ireland. Being the 33d Year of Publication. Compiled and Arranged by

JOHN W. FIELD,

Secretary and General Manager of The Gas Light and Coke Company, London.

Price $5. For Sale by

A. M. CALLENDER & CO., - No. 42 Pine Street, N. Y. City.

AMERICAN METER COMPANY,

NEW YORK, PHILADELPHIA, CHICAGO,
SAN FRANCISCO, ST. LOUIS.

PREPAYMENT METERS.

THEIR CONSTRUCTION IS SUCH THAT THEY MAY BE READILY READJUSTED WHEN THE SCALE OF GAS RATES IS CHANGED.

HELME & McILHENNY,

Established 1848. 1339 to 1349 Cherry Street, Philadelphia. Pa.

MANUFACTURERS OF

Wet and Dry Gas Meters, Station Meters, Provers, Gauges, Etc.

METERS REPAIRED

PREPAYMENT GAS METERS.

Our Own Patents. Strong. Simple. PROMPT ATTENTION. CORRESPONDENCE SOLICITED

METRIC METAL COMPANY,

MAKERS OF

GAS METERS for NATURAL and ARTIFICIAL GAS.

Special Attention given to Repairing METERS of all Makes.

FACTORY AT ERIE, PA.

FOR SALE, NASH GAS ENGINE.

Fifty-horse power, 3-cylinder, latest type. Made by the National Meter Company. Engine can be run either on gas or gasoline. In use less than a year and as good as new. A desirable engine where natural gas is abundant and close regulation is not expected. For further particulars address

BUHL STAMPING CO., Detroit, Mich.

WESTERN GAS CONSTRUCTION CO.,
GAS ENGINEERS AND BUILDERS,
FORT WAYNE, IND.

Coal Gas Plants,
Water Gas Plants,
Oil Gas Plants,
Fuel Gas Plants.

Our apparatus is designed, manufactured, erected and operated under the personal supervision of our own engineers, thus giving buyers the advantage of experience covering every phase of gas enterprise. : : : : : :

The Western Gas Construction Company,
FORT WAYNE, IND.